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Co-operative Publicity.

The scope and plan of the Co-operative Electrical Development Association should receive the serious attention of our readers, as its underlying aim or motive is the greatest good of the greatest number in the electrical field. Mr. J. Robert Crouse, Jr., who has fostered and fomented this idea, is entitled to the utmost credit for the manner in which he has stuck to his campaign, and brought it from the nebulosity of a visionary scheme up to the basis of practical action. He has indeed proved himself a vitalizing force in giving novelty and attractiveness to that which was otherwise somewhat shopworn. There is after all nothing new in the idea of electrical publicity. So far as this journal is concerned, it might be said to have stood for nothing else during the past 30 or 40 years, and it is natural therefore that it should welcome the endorsement which thus comes for all that it has preached and practiced during so long a period. In the past two years, moreover, it has laid particular and special emphasis on the necessity of developing the commercial side of the central station industry, and here again the work of the new Association does but corroborate all that it has been trying to preach. When all is said and done, the central station manager is the objective point of this campaign, and the message to him is that he should reduce the price of his current and wake up to the great opportunities that exist for him to do business. It is possible that his rejoinder might be that his current is already at as low a price as he can afford and that the manufacturers themselves might play an important part by reducing the price of their apparatus. The doctrine that Mr. Crouse preaches, however, and that is embodied in the new Association, is that of co-operation; and it is only by getting together in this way that the best means of promoting electrical welfare will be found. At the present minute there is no fear of publicity in the central station field being overdone, and the new Association has therefore our heartiest good wishes. It can do little harm and may do infinite good.

The Bell Telephone Report.

Elsewhere in this issue is presented an abstract of the remarkable annual report just issued by President Fish of the American Telephone & Telegraph Company for the year 1905. This document is in many respects the most important of its kind that has been issued by a Bell president in many years. It is an extraordinary exhibit of vitality, growth and prosperity, the more remarkable when it is considered that this growth has been made in spite of the persistent and even astounding development of the "Independent" telephone field. Incidentally, there are signs that in spite of centrifugal tendencies, the two systems are drawing together, for while in 1904 the number of independent stations connected into the Bell organization were 167,213, the number reported for last year was no less than 246,337. This is 10 per cent of the total Bell system, but it is not quite certain how large a percentage it is of the independent system. In 1902 the independents reported 998,119 stations, but the last three years has, of course, seen a very rapid growth over that number.

The business done by the Bell system is remarkably large, so that whereas three years ago, in 1902, the number of conversations was slightly over three thousand millions, last year it was nearly four thousand, five hundred millions. The amount expended during the year for new construction and real estate was over $50,000,000, and the total income of the business was slightly over $100,000,000. In our first issue of the year the total income of the local telephone companies of the country was estimated at $140,000,000. This figure was thought to be large by some persons, but it will be seen that according to this basis only $40,000,000 was allowed for the entire independent system. There can be no question that the growth of the whole telephone industry continues to be extremely rapid with no perceptible possibility of diminution for many years to come. In fact, the demand for new capital to make the extensions is among the problems of the industry, and one of the notable financial events of last year was the authorization secured by the Bell system to issue convertible bonds in the aggregate amount of $150,000,000, to be applied to construction. That such money is after all well invested would appear from the fact that the securities held by the parent company being the stocks and bonds of its sub-organizations, carried at a value of $177,000,000, have an actual valuation at the present time of over $221,000,000. In fact, the interest receipts of the parent company show a gain in the past six years of 1,044 per cent, due to the large amounts of money loaned to the sub-companies for their development, but the other advances have been equally noteworthy. Dividend receipts in the past six years have shown a gain of 131 per cent, rentals of 60 per cent and long-distance business a gain of 115 per cent. It is to be borne in mind that the increase in income has been achieved in spite of the competition that has been at once wonderfully efficient in many places and in other places has given service far below cost. The Bell system has itself also in the last five or six years reduced its rates steadily, and it is certain that the minimum is not by any means yet in sight, although as the rates go down the business develops again out of all apparent proportion. It is perhaps no exaggeration to say that the telephone field is the most active one to-day within the range of electrical development, and it might indeed be wished that corresponding gains could be exhibited generally within the central station field.

Economy in Selection of Candle-Power.

The introduction of high candle-power high efficiency lighting units has developed a tendency both on the part of the central station man and of the customer to select larger sizes of these units than will give the best results. For example, both the merchant and the central station solicitor in a desire to put up something which will look big and imposing, are apt to select for the lighting of a store a few lamps of high candle-power rather than a greater number of lower candle-power. Now where a store or other interior is to be so flooded with light that there will be no points between lamps being insufficiently lighted, it is proper to use high candle-power units. It must be remembered, however, that the maximum illuminating efficiency is obtained with small units at frequent intervals rather than by units of an equal total capacity placed at infrequent intervals. For example, a row of 125-watt units placed 8 ft. apart will give better results than 250-watt units placed 16 ft. apart. It is better for the central station man to talk lamps of a low candle-power at frequent intervals to begin with, and then if the customer is not satisfied, it is an easy matter to increase the candle-power; whereas it is usually difficult to reverse the process and install more lamps of low candle-power after the merchant has had high candle-power lamps before him. High candle-power units placed in a store certainly have an advertising value, as they create the impression on the passerby or the casual observer that the merchant is not afraid to spend money on light. When they are used, however, there should be enough of them to provide ample illumination midway between lamps. What is said here is intended merely as a caution to central station men who are thinking of recommending to customers, whose light is now unsatisfactory, the substitution of higher candle-power units taking in the aggregate the same amount of energy as a number of well scattered low candle-power lights already in use. Efforts might better be directed toward equipping the existing low candle-power units with proper reflectors and placing them at the right height. On the other hand, where the low candle-power units are grouped on chandeliers or clusters, the substitutes of single high efficiency high candle-power units will in many cases make a decided improvement.

Auxiliary Poles in Commutator Motors.

Of the numerous improvements made in recent years in the commutator type of electric machinery, perhaps none is more general in its application than the "auxiliary" pole for preventing sparking. On account of the fact that machines which refused to operate at full load with the brushes at the neutral point would commutate satisfactorily at any load when the brushes were shifted, the cause of the sparking has frequently been attributed to the shifting of the field by the armature current. In explanation of the phenomena it was shown that the magnetomotive force of the field current and that of the armature current were electrically in space quadrature, and that the resultant magnetic field shifted in mechanical position with the change in the armature current as the load varied, or with the change in the field strength as the speed was varied. In the issue for March 17 Mr. Norman G. Meade gave a graphical method for representing the resultant field and armature magnetomotive forces, and for indicating the effect of the magnetomotive force of the auxiliary pole in counteracting the distortion of the magnetic field. Although the diagram proposed is accurately appliable only to machines which have uniform core material and are provided with stationary coils completely surrounding the armature, it serves to show in what way a compensating magnetomotive force may be applied to the machines.

It is worthy of note that successful commutation in direct-current machines does not depend upon the existence or lack of an undistorted magnetic field, although a complete compensation of the armature magnetomotive force, both locally and as a whole, is desirable and more or less necessary in alternating-current series motors. In the latter type of machine any uncompensated magnetomotive force of the armature produces a field, which alternates with the circuit frequency and generates a detrimental "wattless" e.m.f. In order that the inductive reactance of the armature circuit may be as small as possible, so that the machine may operate at a high power factor, the compensation in these motors is made approximately complete. In the alternating-current machines the sparking may be attributed largely to the e.m.f. generated in the coil under the brush by transformer action. In the direct-current machine, the transformer action is

absent, and the sparking is due largely to the e.m.f. generated in the coil under the brush by speed action. Thus the determining factor for commutation in the alternating-current machine is the magnetism passing perpendicularly through the coil, while in the direct-current machine the determining factor is the magnetism through which the coil passes perpendicularly. By the use of a small magnetomotive force applied locally at the coil under the brush, it is possible to nullify the field magnetism at this point, and thus to produce an effect equivalent in all respects to preventing the magnetic distortion by the armature current. An additional magnetomotive force is desirable at this same place in order to cause the generation in the coil of a reversed e.m.f. which assists the rapid reversal of the current in this coil. It is evident, therefore, that for direct-current machines it is advantageous to employ a concentrated magnetomotive force at the coil under the brush, while for alternating-current machines the compensating magnetomotive force should be distributed over the surface of the armature.

ON THE CONDITION FOR SPARKING AT THE BREAK OF THE INDUCTIVE CIRCUIT.

The March number of the *Physical Review* contains a paper by Mr. J. C. Hubbard on the above topic. The whole question of sparking and spark coils is relatively old, having first been discovered by Faraday, but it is so extremely complex, and contains so many factors, that but little headway has yet been made towards placing the subject on an arithmetical or engineering basis. The research detailed in the paper relates to determining the velocity which must be given to the contact breaker in the primary circuit of a coil in order that there may be no sparking at that contact. It is well known that the loss of energy occurring in the spark at the vibrating contact of an induction coil is not only a waste in itself, but also that it prevents the full transfer of energy from the primary to the secondary circuit. In other words, it taxes the circuit that gives, and the circuit that takes. Rayleigh has shown that when a primary circuit was opened sparklessly at the velocity of a rifle bullet, a greater potential could be produced in the secondary winding of an induction coil than when using lower contact-breaking speeds, and the best spark-shunting condenser. The experiments made seem to show that the sparkless speed of separating primary contact increases in a straight-line law with the primary current strength. Diminishing the capacity in the primary circuit increased the non-sparking velocity, and increasing the inductance also increased this velocity. The two latter effects are in conformity with the general theory of the subject. The velocities required in the experiments to produce sparkless breaking were of the order of one meter per second. The effect of inserting iron-wire cores into the induction coil was marked, and was in the direction of diminishing the critical velocity. Very much more experimental and theoretical work seems necessary before a spark coil for gasoline automobiles can be completely predetermined by design.

STARTING CONDITIONS OF INDUCTION MOTORS.

One of the difficulties connected with the design of induction motors is found in the fact that a machine which is constructed to exert a large torque at starting gives poor speed regulation under load conditions and possesses an unsatisfactory efficiency at full load. As is mentioned in an article by Mr. R. E. Hellmund on page 666 of this issue, the starting torque of a polyphase motor is equal in synchronous watts to the power dissipated in the secondary windings when the rotor is stationary. A large starting torque requires a large secondary resistance, and if the machine retains the simplicity of the squirrel-cage rotor, it follows that the slip under full load will be large and the efficiency low. The maximum torque which the machine can exert at starting is obtained when the secondary copper loss is at its highest value, which condition exists when a proper balance is made between the secondary resistance and the local leakage reactance of the windings. It is found in practice that better general results are obtained when the secondary has a resistance much below the value required for maximum starting torque, so that where efficiency and speed regulation are of prime importance and the torque must be large at starting, it is necessary to be able to vary the resistance in the secondary circuit.

The article by Mr. Hellmund draws attention to the fact that with constant resistance, the effect of varying the reactance is the same with reference to the value of the current, as varying the resistance when the reactance is constant. In either case, if the constant quantity is small in comparison with the variable one, the effect of the variation is much more pronounced than when the reverse is true. Thus, when the resistance is small, a change in the reactance produces a proportionate change in the current, while, when the resistance is large, a similar change has a negligible effect on the current. It is evident that when a change in the current is due to change in the value of the reactance, the copper loss varies directly with the square of the current, while if a similar change in the current is produced by altering the resistance, the copper loss may remain constant or may even be varied in the opposite direction. Mr. Hellmund shows that, since the leakage reactance depends upon the mechanical position of the secondary with respect to the primary, the starting torque varies considerably according to the position of the rotor. In extreme cases the commercial torque at starting may be much less than the average as obtained by the methods of calculation ordinarily employed.

The above statements relates particularly to polyphase induction motors. The torque of a single-phase induction motor is approximately equal to that of the equivalent polyphase motor multiplied by the speed with synchronism as unity, and hence the starting torque in any case is zero. On page 667 of this issue is given a description of a single-phase motor in which the starting difficulties have been overcome and the operating characteristics have been improved. The machine is used as a repulsion motor when starting and as a single-phase induction motor when full speed is reached, just as is done at the present time in a well-known American type of motor. The improvements introduced include means for gradually converting the machine from a repulsion to an induction motor, and for supplying the exciting magnetomotive force to the revolving secondary instead of to the stationary primary. By removing from the primary coil the wattless component of the exciting current and substituting therefor a power component of current necessary to overcome the added losses, the power-factor of the machine is rendered quite high, the output is increased, and, except in the case of small motors, the efficiency is improved.

Hydro-Electric Power Stations.

Mr. Rushmore's Institute paper, abstracted elsewhere in this issue, is a very good running summary of current practice in design. We are glad to see the stress he lays on reliability of service and commercial considerations, which actually are the controlling factors in power transmission. Plants are installed to earn money, not to demonstrate theses on dynamo and line construction, and the plant that does not pay is, speaking broadly, a badly engineered plant. Reliability, however, is a subject upon which there may be wide and well founded differences of opinion. It is a curious fact that people generally require from electrical apparatus a degree of immunity from trouble that they would not dream of applying to an engine, for instance. This, in a sense, is very complimentary, but it is sometimes also inconvenient. The moment one transmits power from a hydro-electric plant there is a howl for drastic guarantees, based not on any proper danger from interruption of service, but upon a popular delusion that steam plants, which the public in a measure understands, are reliable, while this sending of high-voltage current over a long line is a bit uncanny, and a proper subject of suspicion. A year or so ago a huge engine in the plant of an electric railway system broke down and for several months the cars could not be heated at the rush hours. The matter, serious though it was, passed almost without comment, but it is safe to say that had the cause of trouble been a failure in a transmission plant, a veritable hornet's nest of agitation would have been aroused.

It is a fact that most interruptions of service in electric transmission systems are due not to any failure in the main transmission lines, but to the general distribution system, which generally has a greater absolute mileage of wire, installed under less favorable conditions. Of course, any transmission plant should be installed with due safety precautions, but there is a limit beyond which safety devices cause more troubles than they prevent. The first point that makes for safety is in the hydraulic plant itself. It is very desirable that this should be so arranged that no casual break can put the plant out of service. Proper storage facilities and duplicate pipe lines where necessary are very valuable in getting clear of hydraulic troubles. The station apparatus should have reasonable reserve, but the main point is the line. The tendency toward duplicate pole lines instead of merely duplicate circuits is a very healthy one. Two circuits on the same supporting system are a little better than a single circuit, but not very much, for any really serious failure in a high-voltage line is likely either to involve both circuits or to force a shut down before repairs can be made. It is very difficult to get a clear idea as to the degree of reliability reached in good modern transmission plants. As Mr. Rushmore says, the nature of the service makes a difference in the requirements, but we know of no system, steam or hydraulic, on the lines of which trouble does not occur, to an amount not perhaps compelling a complete shutdown, but still not far missing it. Automatic safety devices prevent some failures of service and precipitate others, and a veracious report of cut-outs tied up and held in on some large systems would make very interesting reading.

Another subject to which Mr. Rushmore gives deserved prominence is the rating of wheels and generators. Hydro-electric plants differ in this respect very radically from steam plants. If a water wheel be designed for good efficiency at its rated load, it will not be efficient on overloads of any considerable amount, and in fact is unlikely to be able to carry them. If designed for a stiff overload it will do badly on normal load. So the water-wheel really determines the whole matter, being the factor which varies most in efficiency with change of load. Mr. Rushmore's suggestion of rating the wheel at 80 per cent gate, is in accord with good practice. It implies a maximum overload capacity of 25 per cent in the generator, which is enough in plants of fair size. This overload means, however, that if less than five units are installed, one of them must be a spare, since with four machines the loss of one could not be fully repaired by overload on the others. It is therefore not uncommon to rate wheels a little lower so as to give an overload capacity of about one-third. As this change may cost several per cent in wheel efficiency, it should be considered in all its bearings. In this respect one can deal more freely with impulse wheels than with ordinary turbines. There is, of course, no need of generator capacity greater than the wheel capacity unless the generator regulation calls for a design that permits more overload as an incidental. With provision for one-third overload in the wheels Mr. Rushmore's suggestion of 40° C. rise and 8 per cent regulation at full load would be running rather close to the line.

Mr. Rushmore passes rather lightly over one subject which is of increasing importance—the installation of auxiliary plants, generally steam. There is no doubt that the average plant can make good and profitable use of an auxiliary, which should be at the main receiving point in order to get inside of line troubles and save energy. The desirable size for such a plant is, however, a much mooted point. A complete full powered reserve is a very expensive affair, for it should be able to take care even of a peak. And auxiliaries may range all the way between this and a mere emergency plant capable of handling in case of need only the most vital parts of the load. In dealing with rather variable streams, of course, a liberal auxiliary can be used to help out, but it is important to remember that this office detracts from the emergency value of the auxiliary. In cases where several hydro-electric plants supply a network, as is now often the custom, the emergency auxiliary need not be planned for the aggregate capacity of the plants, but only for the capacity that may be lost by a single breakdown. Generally the auxiliary will be used both for emergencies and for occasional help at times of heavy load. There are sometimes very severe requisitions made in the matter of continuity of service, and it is probably sometimes desirable to decline the business rather than to be forced into a heavy expense for an auxiliary much larger than is necessary, particularly as the most strenuous customers are likely to be those who expect to pay the minimum price for power. Considering the extent to which hydraulic companies have sold surplus and non-permanent power, electric power companies should not neglect the same opportunity when it can be found. All in all, transmitted power has proved to be reliable and should not be subjected to guarantees which no one thinks of demanding of an ordinary steam plant.

The Berlin International Conference on Electrical Units.

It will be remembered that the Chamber of Delegates of the International Electrical Congress at St. Louis in 1904 recommended that an international commission should be appointed to consider

the discrepancies between the laws relating to electric units in different countries, or between their interpretations, with a view to securing practical uniformity. This resolution was happily put into effect last October by the invitation of the Physikalische Technischer Reichsanstalt at Berlin, addressed to the Bureaus of the various governments, suggesting a conference at Berlin. It appears that the invitation was suggested by the United States Bureau of Standards, and was supported by the National Physical Laboratory of England, as well as by the Bureau Central Météorologique of France. The conference was held at Charlottenburg October 23-25, 1905, and was attended by six delegates from Germany, two from Austria, two from Belgium, one from England and one from America—Professor Carhart. Although these delegates were not officially appointed to represent their respective governments, yet the results of the conference are in many ways as valuable and important as though the governments had been formally represented therein. In fact, the informal nature of the proceedings perhaps facilitated their conduct to a definite conclusion. The fact that such a conference was called, brought into effect and conducted to a formulated series of resolutions published in English, French and German, is a matter for international congratulation. The proceedings of the conference have been published in a pamphlet of 67 pages, mainly in German, by the Reichsdruckerei, of Berlin. An abstract of this publication appeared on page 614 of our last issue.

Six definite questions were taken up by the conference for consideration, relating to the fundamental standards of electric measurement. These, however, centered about one main question, namely, whether the fundamental concrete standard units should be the ohm and the volt or the ohm and the ampere. The Chicago Congress left the matter in some indefiniteness, because the international ohm, ampere and volt were all three defined as concrete standard units—the ohm as the resistance of a certain mercury wire, the ampere as the current that would deposit silver at a definite rate in a definite form of coulometer, and the volt as a certain fraction of the e.m.f. of a certain form and preparation of Clark standard cell. Any two of these three fundamental standards must, however, determine the third by implication, under Ohm's law; so that only two of these units need to be defined in concrete form, and only two should be so defined, in order to avoid errors and misunderstandings. It transpired in fact that the Charlottenburg Bureau of Standards, working on the basis of the concrete ohm and ampere, came to alter the value of the e.m.f. legally attributed to the Clark cell, by a small but appreciable extent, and thus introduced a discernible discrepancy between the voltage of incandescent lamps as determined in Germany and in America.

Two American briefs were filed on behalf of the ohm-and-volt selection, and they are published as appendices to the text of the proceedings. On the other hand, the British physicists took sides with the French and the Germans in favor of the ohm-and-ampere selection, so that the latter view was held by the majority of the conference. Our opinion remains distinctly in favor of that advanced in the American briefs. Nevertheless, the question is only of minor concern from a physical point of view, and either is, or need be, of no concern whatever from an engineering point of view. All that the engineer calls for is that the units he employs shall be the same all over the world, and that his measuring instruments shall not have to be recalibrated, or subjected to a correction factor, when carried from one country to another. No devout Mahommedan was ever more zealous in monotheism than the electrical engineer for one and only one volt. He does not care whether it is derived fundamentally as a fraction of the e.m.f. of a standard cell, or from the drop of potential of an electrolytically determined ampere in a standard ohm. The agreement of the conference in favor of the ohm and ampere as fundamental concrete standards is, therefore, a matter for universal satisfaction, whatever opinions may be held as to the merits of the selection.

On examining the formal decisions of the conference, we have only one criticism to offer, of a technical rather than a fundamental character. These decisions amend the resolutions of the Chicago Congress, from which they have been evolved both historically and essentially. A person adequately acquainted wtih the history of these units would, no doubt, carry the decisions of the Chicago Congress forward in his mind and apply these amendments and additions thereto. But the decisions of the conference should have made reference to the Chicago Congress resolutions, in order clearly to indicate their scope. Thus, the conference decisions define the international ohm as a fundamental electric unit, in terms of the resistance of a certain mercury wire, and also the international ampere as a fundamental unit in terms of the deposition of silver. These are proper decisions concerning concrete standards. They are, we submit, improper decisions concerning fundamental units, unless interpreted as specific amendments to the decisions of the Chicago Congress. The international ohm, as defined by the Chicago Congress, was 10^9 units of resistance of the c.g.s. system of units, or a member of a large and comprehensive system of unit magnitudes. The legalized embodiment of this ohm or its concrete conventional representation, is the particular mercury wire. Consequently, the formal decisions should either have been defined as relating to concrete standards and not to units, or as amendments to the decisions of the Chicago Congress. In course of time, as the history of the subject absorbs the new decisions, the basis for this criticism will doubtless disappear. It will be evident that, theoretically, our ohms and volts are decimally related to the great scientific absolute system of units; but that practically and legally they are given international embodiment in terms of a certain mercury wire, and of the rate of deposition of silver.

It is important to observe that the Weston cadmium cell was formally adopted as the standard cell, thereby changing the decision of the Chicago Congress, which adopted the Clark cell. A practical point in this connection is that the cadmium cell is the subject of a patent or patents, and thus not open to free use. Otherwise this amendment is doubly important. In the first place, the temperature coefficient of the cadmium cell, with free solid hydrated cadmium sulphate, is markedly less than that of the Clark cell. In the second place, the Weston cell can now be calibrated by the various national laboratories in complete uniformity, without affecting national legislation upon the e.m.f. of the Clark cell. In other words, the adoption of a uniform international value for the e.m.f. of the Weston cell will not apparently call for any amendment to the existing legislation of the United States or Canada. Our international volt will not, we think, be illegal. Taken as a whole, the conference of Charlottenburg has earned the thanks of electrical workers all over the world, and will lead, let us hope, to complete uniformity of calibration in future, between the national laboratories of Europe and America.

A. I. E. E. Nominations.

At the meeting of the Council of the American Institute of Electrical Engineers on Friday of last week the report of the scrutiny of ballots for nominations of Institute officers was presented and official nominations made for the offices to become vacant at the end of the present Institute year. For president a total vote of 1,074 was cast, of which Mr. E. W. Rice, Jr., received 551 and Dr. Samuel Sheldon 408. In acting upon the names for president on the proposed list, the Board of Directors departed from the past custom of placing in nomination for president only the member receiving the highest number of votes, and directed that the official ticket shall bear the names of both Mr. Rice and Dr. Sheldon.

Following are the other official nominees: For vice-presidents, Mr. A. H. Armstrong, of Schenectady; Mr. H. H. Humphrey, of St. Louis, and Mr. F. G. Baum, of San Francisco. For managers, Mr. Paul Spencer, of Philadelphia; Mr. Paul M. Lincoln, of Pittsburg; Mr. J. J. Carty, of New York, and Mr. A. M. Schoen, of Atlanta, Ga. Treasurer, Mr. George A. Hamilton. Secretary, Mr. Ralph W. Pope.

The balloting list indicates that the circular sent out fraudulently, purporting to represent the Philadelphia branch of the Institute, produced about 180 votes for the ticket in the interest of which it was issued. It will be recalled that the postal card authorized by the Institute repudiating this circular was not received by members until after the date when the balloting for nominations had closed. If it had been received prior to that date, in all probability very few members would have voted the ballot accompanying the bogus circular, and the distribution of this large vote would have resulted in quite different totals for the guidance of the Board of Directors in making up its official ticket.

Annual Meeting of the Association of Electric Lighting Engineers of New England.

The fourth annual meeting of the Association of Electric Lighting Engineers of New England was held at the Parker House, Boston, on March 21. A large number of central station experts were present, and the following officers were elected for the ensuing year: President, W. C. Woodward, Providence; vice-president, N. T. Wilcox, Lowell; secretary and treasurer, Welles E. Holmes, Newton. Executive Committee—H. Bottomley, Fall River; S. Fred Smith, Salem; W. L. Mulligan, Springfield; G. R. Stetson, New Bedford; W. R. Eaton, Cambridge, and G. L. Sadler, Nashua. It was voted to hold at least three meetings per year hereafter.

The meeting was divided into morning and afternoon sessions, at which the following papers were presented: "Line and Station Protection Against High Potentials," by Mr. G. E. Palmer; "Discrimination in Rates," by J. S. Codman; "Progress in Methods of Electric Lighting," by Dr. Louis Bell; "Best Methods in Advertising," by Mr. Converse D. Marsh; "Alternating-Current Motors," by Mr. W. A. Layman; "Recent Progress in Arc Lighting," by Mr. Richard Fleming. Abstracts of these papers and of their discussion will appear in our next issue.

Electric Smelting at Sault Ste. Marie.

The experimental trials of the Héroult electric furnace carried out at Sault Ste. Marie under the supervision of the Canadian Government, have been concluded. While the official report has not yet been issued, Dr. Haanel, who represented the Canadian Government at the trials, has recently lectured on the results and stated them to be entirely successful. From Dr. Haanel's remarks it would seem that there are good prospects for introducing the electric furnace for pig iron production in Canada. The electric smelting of pig iron containing some four per cent of nickel is stated to be demonstrated a commercial success, and it is reported that the experimental plant at Sault Ste. Marie has been taken over by the Lake Superior Corporation and is now being conducted as a commercial plant. The nickel pig thus produced commands about double the price of ordinary cast iron.

Annual Report of the Bell Telephone System.

The annual report of President F. P. Fish, of the American Telephone & Telegraph Company has just been issued. It is a more voluminous document than usual, Mr. Fish discussing various problems and aspects of telephonic development with unusual freedom and frankness. From the technical standpoint the most interesting figures are those given in the subjoined table for the company and all its licensees:

	1905.	1904.	1903.	1902.
Exchanges January 1	....	....	1,609	1,514
Branch offices	4,532	4,080	....	....
	....	....	2,131	1,861
Total miles wire	4,778,282	3,549,810	2,983,189	2,443,750
Total stations	2,241,367	1,799,633	1,525,167	1,277,983
Miles of pole lines	145,535	136,547	130,178	122,409

Mr. Fish says: "Since January, 1900, the number of telephones in the hands of our companies increased from 1,580,101 to 5,698,258; the total number of stations using Bell telephones, from 675,761 to 2,528,715; the miles of wire in toll and exchange use from 1,518,609 to 6,043,518; the number of officers and employes of all classes, from 29,599 to 87,212, and the number of yearly conversations, from 1,708,800,000 to 4,479,500,000. The American Bell system of the United States now exceeds, in the number of subscribers, mileage of wire and extent of traffic, the telephone systems of Great Britain and all of Continental Europe combined."

The growth in traffic as well as in necessary investment is enormous. The amount added to construction and real estate by all the companies, excluding sub-licensees, constituting the system in the United States during the year 1905, was:

For exchanges	$36,771,312
For toll lines	9,832,204
For land and buildings	4,177,390
Total	$50,780,906

"The amount added in 1900 was $31,619,100; in 1901, $31,005,400; in 1902, $37,336,500; in 1903, $35,368,700, and in 1904, $33,436,700, making the grand total of expenditure upon these properties during the six years $219,547,306.

"The plant is to a large extent stable and standard. Fifty-four and one-tenth per cent, in miles, of all the exchange wire in the country is now in cables under ground. At the end of the year 1905 all except about 20 per cent of the exchange wire in the Bell system was in cables, overhead or underground.

"At the present time the companies making up the Bell system have in use not less than 320,000,000 lb. of copper wire, much of it in cable of a permanent type, the value of which, as copper, if removed and sold, it is easy to estimate; not less than 8,000,000 poles and 95,000,000 duct feet of underground conduit are installed and in use to support or contain this wire."

The income account for 1905 shows dividend receipts from sub-companies of $8,897,879; rental of instruments, $3,896,151; telephone traffic, $6,529,556; real estate, $82,384; interest, $2,596,858; a grand total of $21,712,831. The expenses of administration were $1,220,460; legal expenses, $93,126; interest and taxes, $3,578,681; telephone traffic, $3,786,524; a total of $8,678,792. This left a net revenue of $13,034,038, out of which dividends were declared amounting to $9,866,355, leaving a balance of $3,167,683. Of this there was carried to reserve $1,743,295 and to surplus $1,424,388. Mr. Fish supplies the subjoined interesting table as to the total Bell telephone capitalization in the United States:

Entire capitalization (stock, bonds and all obligations as above) of all the companies, including this company	$334,524,583
Number of stations (excluding sub-licensee and private line stations)	2,241,367
Average capitalization per station	$149
Deducting cost toll lines	$99,293,987
Balance, cost of exchanges	$235,230,596
Average capitalization per station (excluding toll line investment)	$105
Miles of toll wire	1,265,236
Average investment per mile of toll wire	$78

Elsewhere in the report Mr. Fish states that the total income of

the whole Bell system was $100,440,264; and the total expenses were $74,110,795; the ratio of expense to gross income being 74 per cent, or for strictly telephone operation about 73 per cent.

President Fish discusses with fullness the independent telephone competition, and takes occasion to emphasize all the familiar arguments against the undesirability of having two or more competitive telephone services in any given place. He states that already 246,337 exchange and toll stations operated by independent systems are connected into the Bell network. This is probably somewhat more than 10 per cent.

The report closes with a reference to the successful placing of $100,000,000 convertible bonds for extension purposes, out of the $150,000,000 voted last December. This new capital will, it is estimated, carry the development of the business well into 1908.

March Meeting of the American Institute of Electrical Engineers.

At the meeting last week of the American Institute of Electrical Engineers, Mr. T. Commerford Martin, as chairman of the building fund committee, announced that there has been subscribed a total amount of $132,389, or more than two-thirds of the sum needed for the land upon which the United Engineering building will stand. Of this amount $87,000 has been collected.

During the month the committee received from the American Telephone & Telegraph Company, the Western Electric Company, the New York Telephone Company, and the New York & New Jersey Telephone Company a joint subscription of $25,000, and from Mr. Clarence H. Mackay, president of the Postal Telegraph & Cable Company, the generous personal subscription of $5,000, both of which have been collected. On the day of the meeting there was received from the Edison Electric Illuminating Company of Brooklyn a subscription of $1,000.

The secretary read a report from the Board of Directors giving the results of balloting for nominees for the coming election, and submitting the ticket compiled by the Board. Annual election to be held on May 15. This ticket will be found in another column of this issue.

The following papers were presented: "Some Features Affecting the Parallel Operation of Synchronous Motor Generator Sets," by Mr. J. B. Taylor; "Notes on the Design of Hydroelectric Power Stations," by Mr. D. B. Rushmore, and "The Relation of Load-Factor to the Evaluation of Hydroelectric Plants," by Mr. S. B. Storer. The paper by Mr. Storer is reprinted on page 669, while abstracts of the papers by Mr. Taylor and by Mr. Rushmore are given on pages 668 and 670, respectively.

In discussing Mr. Taylor's paper, Mr. W. L. Waters stated that personal experience tended to show that the results from the parallel operation of synchronous motor-generator sets are not quite so simple as one would expect from a perusal of the paper. He was inclined to attribute the erratic behavior of the sets to changes in the power factor of the different phases, especially when polyphase generators are used for single phase distribution. As regards the starting, he thought the method which employs two pointers on a single synchronism indicator dial is much superior to the method of reversing the poles, because the latter method places an unnecessary strain on the machine. He expressed his appreciation of the very simple and lucid explanation of the operation of synchronous motor-generator sets as given by Mr. Taylor. He thought, however, that the problem is one in which practice is more valuable than theory.

In reply to the criticism by Mr. Waters, Mr. Taylor said that the objection is not valid, because every motor must at some time go through with the process of slipping one pole and it must be designed to withstand the strain. Moreover, in practical operation, the slipping is done on low voltage, so that the increase in the current and the strain on the machine is not great. Any well built set will withstand this treatment indefinitely.

The papers by Mr. Storer and by Mr. Rushmore were not discussed.

Test of a 1500-Kw. Curtis Turbine.

The following data are from a test of a 1,500-kw Curtis turbine, made by Mr. C. P. Sparks, chief engineer of the County of London Supply Company. This company has recently installed two turbines of this capacity, one in its City Road and the other in its Wendsworth Station. The turbines are of the four-

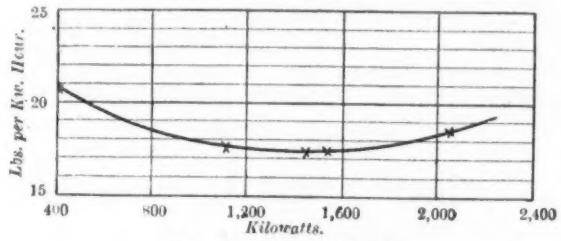


FIG. 1.—TEST READINGS.

stage type and are mounted on sub-base condensers. The alternators are two-phase, generating 2,200 volts at 50 cycles and 1,000 r.p.m. When running continuously at full load, the guarantees were for a temperature rise of 40° C. and a further rise of 15° C. when the machine is run for three hours at 2,250 kw. The units can be loaded as high as 3,000 kw for short periods when condensing.

In commenting on these tests, our London contemporary, *The Electrician*, refers to the great value of independent tests of this nature, and points out that Mr. Sparks has included among the data the amount of energy absorbed by the auxiliaries, figures which are often passed over in silence by experimenters. As more interesting than the low steam consumption at full load (17.25 lb. per kw-hour excluding auxiliary, and 17.6 lb. including auxiliaries), he notes that the consumption increases very little down to ⅓ full load. While the tests were favored by an extraordinarily high vacuum, on the other hand, the steam was superheated by 60° F. only. Reference is made to a test of a 1,200-kw Brown-Boveri-Parsons three-phase turbo-unit installed about two years ago at Rheinfelden, the steam consumption of which ranged from 15.9 lb. per kw-hour at 1,440 kw to 21 lb. at 378 kw. The vacuum was approximately the same as

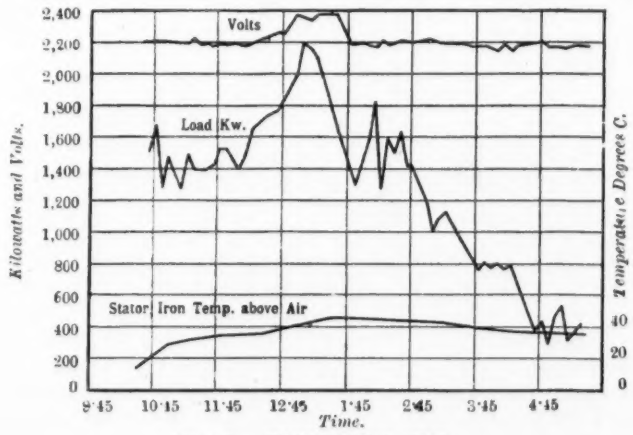


FIG. 2.—TEMPERATURE TEST.

in the test by Mr. Sparks, but the steam was superheated to no less than 250° C. on an average, which our contemporary considers quite accounts for the difference in performance.

During the tests the power taken by the auxiliaries amounted to 33 kw at one-quarter load (circulating water 21.5, excitation 5.7, air and foot-step pumps 5.75, total = 32.95); and 50 kw at full load (circulating water 36, excitation 7.25, air and foot-step pumps 6.75 = 50), resulting in a total steam consumption of 17.8 lb. per kw-hour when the set was delivering 1,500 kw.

Steam consumption tests were made during January at loads varying from 400 to 2,050 kw, the maximum load carried during the test being 2,200 kw. During the test the steam consumption was measured by weighing the hot-well discharge continuously in duplicate tanks holding six minutes discharge at full load. The test readings at each load, plotted in Fig. 1, were taken over 30 minutes, the reading at full load covering two hours.

The output was measured by integrating wattmeters checked by ammeter and voltmeter readings (the whole of the instruments being calibrated at the Board of Trade laboratory after the trial). The artificial load was obtained by passing the current between iron plates immersed in running water. During the test the superheat at the turbine varied from 48° F., to 62° F., the steam pressure from 146 lb. to 154 lb. per sq. in., and the temperature of the circulating water was 43° F.

In order to shorten the temperature test (Fig. 2), after running two hours at full load normal pressure the load was increased to a maximum 2,200 kw at 2,370 volts; the increased iron losses under these conditions gave a temperature rise of 44° C. for the stator iron at the end of four hours' run. The load and pressure were then reduced to normal full load, giving a temperature rise of 42° C. at the end of the fifth hour; at this time the corresponding temperature rise of the end windings of the armature was 34° C., while the field coils rose 12° C. measured by increase of resistance.

Report on Chicago Lighting Rates.

Mr. Bion J. Arnold and Mr. William Carroll, city electrician of Chicago, acting as experts to advise the Chicago Council Committee on Oil, Gas and Electric Light, have submitted a report on the rates of the Chicago Edison and Commonwealth electric companies. The report gives the results of the investigation of the affairs of these two companies so far as relates to rates, and makes recommendations as to what constitutes a reasonable maximum rate of charge for incandescent lighting. The report is divided into two parts, one of which discusses the question of a reasonable maximum rate on the assumption that the companies cannot be compelled to accept less than cost for its service; and the question of a reasonable rate on the assumption that the companies can be required to serve a portion of their customers at less than cost, provided the returns from the total lighting business are reasonably profitable. A valuable feature of the report is a discussion of the subject of rates, with particular relation to the use of the Wright demand system of metering. Next week this section of the report will be printed in full.

In the discussion of the first question, it is stated that the maximum rate of the Chicago companies at present is 20 cents per kw-hour with a 20 per cent discount for prompt payment, giving a net maximum rate of 16 cents per kw-hour. With the present maximum rate there is no doubt some customers are served at a loss, and the company has compiled figures showing that this is true of a large percentage of customers, numbering no less than 10,000. The report places at 25 per cent the proportion of customers that at present are not giving a profit. Although the number of customers served at a loss may appear large, the total actual loss to the company in dollars, as compared to the total income from all customers, is small for the reason that only those using a small amount of current are supplied at a loss. It is stated that though theoretically each customer should pay for his own service, on the same theory, however, every merchant should charge proportionately more for the delivery of small purchases than for large ones; that is to say, if a single pound of coffee or a yard of silk is delivered, a higher charge per pound or yard should be made than if such small purchases were delivered with a larger bill of goods. This policy would not be considered good business, and as other merchants consider it to their interest to do a considerable amount of small business at a loss, it is not surprising to find that public sentiment is in favor of reducing the maximum rate for lighting, even if the supply company must make up this loss by slightly greater charge on larger sales than would otherwise be demanded. The problem, therefore, resolves itself into establishing a fair balance, and involves the relative rights of the "short hour" and of the "long hour" consumer, of the wholesale customer and of the producer, and should not be settled entirely in favor of any one and at the expense of the others. If it is maintained that the companies should not do any business whatever at a loss, then the present maximum rate cannot be reduced. It is only, however, by taking a broad view of the entire business that a conclusion can be arrived at as to whether the maximum rates can be reasonably reduced.

In the discussion of the second question, namely, as to what constitutes a reasonable rate on the assumption that the companies can be required to serve a portion of their customers at less than cost, provided the returns on the total lighting business are reasonably profitable, a number of combinations of maximum and minimum rates are made and discussed, and an analysis is given of the financial situation of the company.

The final conclusions of Messrs. Arnold and Carroll are that the Edison and Commonwealth companies can afford to reduce their lighting rates; and that their offer to reduce their rates to 14 cents for the maximum rate and 9 cents for the secondary rate for two years from the present time, and to 12 and 8 cents for the next following three years, may be considered reasonable and fair. A thorough investigation of the affairs of the company might show that they could offer to reduce the rates to 10 cents and 5 cents (equivalent to a flat rate of 6⅔ cents), but from all the figures submitted this rate at the present time would be a hardship and would probably seriously embarrass the companies; it can, however, reasonably be expected that eventually the companies can afford and probably will accord this latter rate.

Boston Meeting of Illuminating Engineers.

About seventy-five representatives of the electric light, gas and kindred industries were present at an informal meeting, held in Boston, March 20, preliminary to the organization of a New England Chapter of the Illuminating Engineering Society. The meeting was called to order by Mr. J. S. Codman, and Mr. John Campbell was chosen to fill the position of chairman. Mr. L. B. Marks, of New York, president of the parent society, said this was the first meeting to form a branch society, and that a movement was on foot to form the second in Chicago. He laid stress on the fact that men engaged in all kinds of business concerned with illumination were wanted in the organization, including architects, contractors and fixture dealers. While any antagonism with existing organizations was to be avoided, it was considered distinctly desirable to have a new and indeperdent organization rather than to become a wing of any already established. Such a society could do a valuable work in impressing the public with improved devices and methods of illumination.

The illustrated paper on the inverted gas mantle lamp, presented by Victor A. Rettich before the New York society, was read by J. S. Codman, of Boston. The discussion that followed the reading of the paper in New York was read by W. W. Cummings, of the Boston Consolidated Gas Company, and there was further discussion by persons present. Mr. E. L. Elliott read his paper, presented in New York, on the flaming arc lamp, or, as he preferred to call it, the luminous arc. Dr. Louis Bell, Mr. W. D'A. Ryan and others discussed the papers of the evening. Mr. Ryan illustrated his remarks by a series of curves showing the distribution of light in the different forms of arc lamps.

Twenty-six of those present signed applications for membership and a committee, consisting of Dr. Louis Bell and Messrs. J. S. Codman, W. W. Cummings, Charles B. Burleigh, H. B. Brown, and Mr. John Campbell, was appointed to perfect and present plans for organization at a meeting to be held in April. At present there are nearly fifty members of the society in New England and the work of the local chapter is expected to bring the membership up to the hundred in a short time.

Wireless Telegraph Litigation.

On March 19 Chief Justice Fuller issued an injunction, on the representation of the U. S. Circuit Court of New York, commanding the De Forest Wireless Telegraph Company to "forever desist from, directly or indirectly, making or causing to be made, using or causing to be used, or vending to others to be used, disposing of in any way, or advertising or offering for

sale, any system of wireless telegraphy, or apparatus used therefor, by which electrical signals are transmitted and received, containing, embodying or employing" the inventions and improvements or discoveries granted in claims 3 and 5 of the reissued Marconi patent No. 11,913, dated June 4, 1901.

As was noted at the time in these columns, the above claims were upheld by Judge Townsend in an opinion dated April 11, 1905. The text of the two claims is as follows:

"3. The combination, in an apparatus for communicating electrical signals, of a spark-producer at the transmitting station, an earth connection to one end of the spark-producer, an insulated conductor connected to the other end, an imperfect electrical contact at the receiving station, an end connection to one end of the contact, an insulated conductor connected to the other end, and a circuit through the contact, substantially as and for the purpose described.

"5. The combination, in an apparatus for communicating electrical signals, of a spark-producer at the transmitting station, an earth connection to one end of the spark-producer, an insulated conductor connected to the other end, an imperfect electrical contact at the receiving station, choking-coils connected to each end of the contact, an earth connection to one end of the imperfect contact, an insulated conductor connected to the other end, and a circuit through the coils and contact, substantially as and for the purpose described."

On March 20 Judge Lacombe of the above-mentioned court issued an attachment against Mr. Abraham White, president of the De Forest Company, for failure to obey a writ directing him to appear on February 26 before a Master of the Court, to give evidence in a certain suit and pending accounting between the Marconi and De Forest companies.

Co-operative Electrical Development Association.

A joint meeting of the different electrical interests, affected by the public consumption of electrical current and electrical apparatus, was held on Friday, March 23, at the Imperial Hotel, New York, upon call of the Co-operative Electrical Development Association, organized by Mr. J. Robert Crouse, Jr. The object of the meeting was to review the work already done along the lines made familiar to the readers of this journal, to examine the plans proposed for the future and to discuss a suggested basis of organization. This meeting, which was held at 3 p.m. on the day in question, was well attended and was called to order by Mr. E. E. Jackson, Jr., who outlined the work to be done in the way of cultivating public interest in electricity, and who spoke particularly from the standpoint of his connection with the incandescent lamp industry. Mr. J. R. Crouse, Jr., then presented an admirable paper, in printed form, occupying some 45 printed pages, in which he went over the ground of the proposed united action and advocated the plan of profitable co-operation with which his name has become connected. He stated that 45 electrical manufacturers who have seen the plans develop during a year and a half past have given effective expression to their confidence in them by the appropriation of $60,000 for the partial execution of the scheme during the next three years. The paper called attention to the great market represented in the electrical field by the two charts, which were shown on the walls, illustrative of the extent to which electricity has been pushed and the manner in which many of the central stations had not lived up to their opportunities. It was stated that for the purpose of putting the entire industry in touch with the co-operative work under way, and of enlisting general co-operation, a mailing list of 4700 individuals identified with the electrical business had been prepared and duly circularized, while the central stations of the country were also included in the propaganda. The paper was in many respects an amplification of the one presented by Mr. Crouse at Denver last year, but embodied a great deal of additional information and argument. It was accompanied by several exhibits, which were distributed to each person in attendance.

The subject of publicity and advertising, etc., was then taken up from various standpoints, and was discussed in papers or in impromptu remarks, as follows: "Possibilities of Newspaper Commercial Publicity," Mr. Ivy L. Lee; "Possibilities of Magazine and Periodical Advertising," Mr. E. E. Calkins; "Possibilities of Co-operative Work," Mr. Paul Spencer; "The Co-operative Movement from the Central Station Standpoint," Mr. W. H. Blood, Jr., President of the National Electric Light Association; "The Co-operative Movement from the Jobber's Standpoint," Mr. F. Bissell; "The Co-operative Movement from the Contractor's Standpoint," Mr. J. H. Strong, President of the National Electrical Contractors' Association; "The Co-operative Movement from the Trade Paper's Standpoint," Mr. J. M. Wakeman, of the ELECTRICAL WORLD; "The Co-operative Movement from the Manufacturer's Standpoint," Mr. A. W. Burchard. A number of very interesting points were presented and at the close of the meeting resolutions were passed as representative of the sense of the conference.

It was moved by Mr. Anson W. Burchard, assistant to the president of the General Electric Company, and seconded by Mr. W. H. Blood, Jr., President National Electric Light Association, that "It is the sense of this meeting that the Co-operative Commercial Campaign for the purpose of increasing the use of electric current by the public for light, heat and power, as both an end and a means to the increased demand for electrical apparatus and supplies as presented and discussed, gives good promise of highly profitable returns to all concerned, and that the general plans for its prosecution through the Co-operative Electrical Development Association can be undertaken along equitable and practical lines."

It was moved by Mr. Anson W. Burchard and seconded by Mr. W. M. MacFarland, Acting Vice-President of the Westinghouse Electric & Manufacturing Company, that a committee of eleven or more representatives of electrical interests be appointed by the chair for the purpose of considering the plans submitted for the organization of the Co-operative Electrical Development Association, and to complete and agree on a practical form of organization with a view of putting the same into operation. It was

"RESOLVED further, that this Committee be authorized to confer on the subject with co-operating committees already appointed, or other representatives which may be appointed from other well defined lines of the trade, so that adequate provision may be made in the plans of organization for immediate moral co-operation, as well as possibly financial co-operation at a later date.

"RESOLVED further, that the plans of organization when completed by this Committee be submitted to the representatives of the interests present, so that the entire proposition may be passed upon by their respective bodies or companies.

"When, in the opinion of this Committee, a sufficient number of the interests have agreed to co-operate in the work it shall be authorized to perfect the organization and to supervise its initiatory work."

The Chairman of the meeting appointed the following Committee as covered by the foregoing resolutions: Mr. W. M. MacFarland, Acting Vice-President of the Westinghouse Electric & Manufacturing Company, Chairman; Mr. J. R. Lovejoy, General Electric Company; Mr. Walter Cary, Sawyer-Mann Electric Company; Mr. A. D. Page, General Electric Company; Mr. F. S. Terry, National Electric Lamp Company; Mr. W. H. Swope, Western Electric Company; Mr. W. C. Bryant, The Bryant Electric Company; Mr. F. J. Newbury, John A. Roebling's Sons Company; Mr. A. T. Clark, American Circular Loom Company; Mr. W. H. Blood, Jr., President The National Electric Light Association; Mr. F. Bissell, The F. Bissell Company, representing the electrical jobbers; Mr. James R. Strong, representing the electrical contractors. It is probable that other members will be added to this committee from other interests which it was expected would be present and whose representatives were unavoidably absent.

The serious business of the afternon was supplemented by a banquet in the evening at the Imperial, when the general subject was returned to by numerous speakers, but with lighter

touch. Among those who spoke were Messrs. C. B. Humphrey, W. H. Blood, Jr., J. C. Fish, Paul Spencer, M. K. Eyre, A. W. Burchard, A. D. Page, C. A. Parker, Converse D. Marsh, S. O. Richardson, Jr., and J. R. Crouse. Mr. W. M. MacFarland was a most efficient and facetious toastmaster, and the proceedings were also enlivened by the performance of a mandolin band. During the evening the badge of the new organization was distributed in the shape of a neat little enameled pin carrying the initials of the Association, the magnet which is its emblem and the legend which is its war-cry "All together all the time for everything electrical."

A document of interest and value that was distributed was the legal form of certificate of incorporation and the tentative by-laws for the Association, prepared by the legal department of Mr. H. L. Doherty, the main point being that active members of the Association would be eligible upon payment to the body of a fixed percentage on all or a portion of their sales covering a period of three years.

Vapor Electric Lamps.

Two patents issued March 13 to Peter Cooper Hewitt describe means whereby the light from a mercury vapor lamp may be much improved in quality. Mercury or other suitable material is used, as heretofore, for the negative electrode, and associated with the vapors therefrom is some other gas, the presence of which will modify the light given off by the mercury vapor. This added gas or vapor will act as a conductor in the tube and give out its characterized color or spectrum under the influence of electric current, if means are provided for condensing the vapor volatilized at the negative or mercury electrode in the vicinity of said electrode, thus preventing the vapors developed there from acting as the sole conductor through the entire body of the container. This condensation is provided for by a suitable cooling chamber at or near the negative electrode, consisting of a spherical enlargement of the base of the tube. The lamp will then operate with a dual light, the current leaving the upper or positive electrode within the fixed gas or vapor and then transferring itself to the vapor developed at the lower or negative electrode, which it will enter and traverse in the usual manner. Various gases may be used for the purpose indicated, but neon or one of the recently discovered inert gases, or a gas that is not chemically active, is preferred; nitrogen and argon are also named in this connection.

A patent granted on the same date to Mr. D. McFarlan Moore relates to a method of manufacture whereby a vacuum tube may be produced having a contained material of such character that it shall form a source of supply to the gas which forms the source of light within the tubes. The object of the invention is to secure the presence in a vacuum tube in order to affect the quality of light, a material comprising an electrolytically treated organic substance, preferably one of which nitrogen is a constituent. Vacuum tubes containing only gas and vapor are of comparatively short life, but this objection may be obviated by introducing chemicals into the tube as a source for supplying fresh gas as rapidly as there is deterioration of contained gas under the action of current. A difficulty in doing this, however, is that all chemicals of suitable quantity for the purpose have acted to change the necessary degree of air refraction in the tube through giving forth their gases too fast. The patent relates to the manner of overcoming this latter difficulty, which is by the introduction into the tube of an organic substance which previously to the sealing off of the lamp has been subjected to electrolytic action. The materials from which best results have been secured are stated to be obtained by subjecting an organic compound, preferably an aromatic hydrocarbon, such as benzine, or a derivative thereof, such as benzoic (with nitrogen) to electrolytic action. This substance is uniformly distributed over the interior wall of the tube by rotating the same, heat being applied externally when necessary to cause the substance to adhere to the tube. The tube is then sealed, connected with a suitable source of electricity and exhausted. The tube with the coating of material described by this process may then be used entirely as a complete manufactured device, but ordinarily only a section of tubing of this kind is used, forming the end portion of a commercial tube.

CURRENT NEWS AND NOTES.

NEW YORK CENTRAL FARES are likely soon to be reduced by the electrification. Announcement of lower fares between New York City and suburban towns reached by the lines of the New York Central, as soon as the electrification of the road is completed, has been made in a letter by the company to the state railroad commission. The letter said that the electrification of the road would be completed within a few months.

N. E. L. A. TRANSPORTATION.—Mr. G. F. Porter, master of transportation of the National Electric Light Association, states that the Central Traffic Association and the Southwestern Excursion Bureau have authorized a rate of a fare and one-third from all points in their respective territories to Atlantic City and return for delegates and their friends attending the twenty-ninth convention of the Association, to be held June 5 to 8, 1906.

CHICAGO ELECTRICAL MEETINGS.—Mr. J. L. McQuarrie read a paper on "Telephone Engineering as a Profession" before the Chicago branch of the American Institute of Electrical Engineers, March 20, which excited considerable interest and discussion. A meeting of the electrical section of the Western Society of Engineers was held March 16, at which Prof. P. B. Woodworth, of Lewis Institute, led a discussion on "Schools, Engineers and Employes."

NATURAL GAS ILLUMINATION.—The village of Columbiana, O., is bringing suit against the West Virginia Natural Gas Company to compel it to cease supplying local residents with natural gas for illuminating purposes. The gas company was given a franchise for heating purposes some time ago, with the express stipulation that it should not enter the lighting field, as the village owns a municipal lighting plant, and it is feared that the plant will prove a failure if the lighting load is reduced. A number of citizens who have been using gas avow their intention of testing the Council's right to restrict them to the use of electricity as it is contended that the electric light is poor, more expensive than gas, and there is no day service.

TELHARMONY.—On March 24, a score of electrical engineers, journalists, bankers and others interested in the remarkable new invention "Telharmony," of Dr. Thaddeus Cahill, went to Holyoke, Mass., by special car, to see the apparatus and hear a concert of instrumental music rendered by the machine. Among the party were Gen. Eugene Griffin, Prof. Richards, of Columbia University; Mr. E. E. Higgins, publisher of *Success;* Mr. H. S. Collette, secretary J. G. White Co.; Mr. J. W. Middendorf, of the Baltimore banking house; and Messrs. Oscar T. Crosby, F. C. Todd, T. C. Martin, G. H. Guy. The apparatus was first inspected at the water-power factory and the music heard there. An elaborate concert was then given at the Hamilton Hotel, two miles away, where the receiving telephone was installed in the ball room, a chamber capable of accommodating three or four hundred people. The keyboard at the factory was played by three performers in succession; and one or two duets were given, the music being classical, operatic, popular and ragtime. The machine furnishing the currents has been built for New York, and is to be set up in this city in May. An interesting feature of this notable performance was the fact that about 400 telephones were in circuit at the same time, to illustrate the facility of distribution, but were "choked" in sand, as the one receiver, consuming three watts, was all the auditors needed to deliver to them sweet sounds from the distant "music distillery."

THURY SYSTEM IN GREAT BRITAIN.—Messrs. Dick, Kerr & Co., of London, have obtained a license for the Thury series direct-current power transmission system for Great Britain and its colonies.

WIRELESS STATIONS SOLD.—The De Forest Wireless Telegraph Company turned over to the Navy Department last week stations at Pensacola, Key West, San Juan, Porto Rico; Guantanamo, Cuba, and Colon, which the company had operated. The total paid by the Government was $65,000, or $13,000 for each station.

NEW PACIFIC CABLE.—It is announced from Manila, P. I., that the cable laying steamer *Silvertown* landed the shore end of the Commercial Pacific Company's cable there on March 24 and began paying the cable out across Admiral Dewey's former battle line toward Shanghai.

RAILROAD TELEPHONY.—A special dispatch from the West states that an independent long-distance telephone line will be equipped by the Union and Southern Pacific roads between Omaha and San Francisco for use by trainmen and officials. Commercial business may be accepted over the line.

PHILADELPHIA TRAVEL.—Large plans are in view for increasing traffic facilities in Philadelphia. By an agreement reached by Mayor Weaver with the Philadelphia Rapid Transit Company, that company undertakes to complete, within three years, subways under several streets in the business center of the city and an elevated railway from the southern section of the city to Frankford.

BLOCK SIGNALS.—Mr. E. H. Harriman has instructed Mr. Julius Kruttschnitt, director of maintenance and operation of his roads, to begin work immediately with a view to installing 2,342 miles of automatic electric block signals, which will cost nearly $3,000,000. The signals are to be placed over the entire line of the Union Pacific and Southern Pacific roads between Omaha and San Francisco, a distance of 1,800 miles, and also between San Francisco and Los Angeles, on the Southern Pacific, a distance of 542 miles. This is believed to be the most extensive piece of electrical work of the kind ever undertaken.

PUSH BUTTON VOTING.—Preparations are making to convene the Douma, the first Russian national parliament. The seats to be occupied by members of the National Assembly in the Tauride Palace there have been equipped with electrical apparatus similar to the system proposed several years ago for use in the House of Representatives at Washington, by which members press buttons and register their votes at the clerk's desk, thus avoiding the delays of roll calls. It will perhaps be remembered that Mr. Edison's first invention was an electric voting system for legislatures. The absence of enthusiasm in its reception rather discouraged him at the time.

GEOPHYSICAL RESEARCH.—The Carnegie Institution of Washington has acquired five acres of ground alongside of Rock Creek Park, on which to construct a laboratory for geophysical research. The investigations will be in charge of Prof. Arthur L. Day, of the United States Geological Survey. The undertaking is the most important of its kind. A study will be made of the minerals composing the earth's crust, with a view to determining scientific facts relative to the earth's formation that heretofore have baffled geophysicists because of the lack of facilities for obtaining accurate information. The apparatus with which the experiments will be conducted is new of its kind, and through the assistance of the Carnegie Institution scientists will obtain data of great value. A good deal of electrical work will be involved.

ELECTRICITY ON SHIPBOARD.—The more modern the steamship the larger her electrical equipment. The largest and most complete electric installation ever fitted on board ship is that for the new Cunarder, the *Mauritania*, now building at Wallsend, England. The vessel will be lighted by about 5,000 lamps of 16 cp, which is more than double the number fitted on the *Cedric*. The electric passenger elevators are to be erected for conveying the passengers between the six decks, two elevators for luggage and six smaller elevators for the mails, etc. There will be a telephone exchange on board, which will connect the chief passenger sections of the ship with the officers', and there are also to be special telephones from the bridge. There will also be various electric heaters and electric curling tong heaters for the women passengers.

SHADOWS WE ARE, but whether we are all the kind of shadows suggested in the subjoined dispatch will require a good deal of proof. A special cable message from London of March 24 says: "In the course of a lecture before the Psycho-therapeutic Society Dr. Ward announced that Prof. Elmer Gates, of Washington, D. C., who has been experimenting with light rays, has found about five octaves above violet a form of waves similar to X-rays. Under these rays living objects throw a shadow which exists only as long as there is life in the object. A live rat was placed in a hermetically sealed tube and held in the path of the rays in front of a sensitized screen. So long as the rat was alive it threw a shadow. When it was killed it became suddenly transparent. 'Here,' said the lecturer, 'there was a strange phenomenon. At the very instant the rat became transparent a shadow of exactly the same shape was noticed to pass, as it were, out of and beyond the glass tube and vanished as it passed upward on the sensitized screen.'"

AUTOMOBILE CLUB BUILDING.—The cornerstone of the new house of the Automobile Club of America, in New York City, was laid on March 21, on West Fifty-fourth Street, by Dr. S. S. Wheeler, who in addition to being president this year of the American Institute of Electrical Engineers, is chairman of the building committee of the club. Past-President Shattuck made a prophetic speech, a copy of which went into the stone with other records. Quoting a verse from the Bible to the effect that "the chariots shall jostle one against another in the broad ways," he spoke of the wonders of electricity and steam in the last century, and concluded with the prediction that in view of the success of ballooning, the automobile will in turn be superseded by the flying machine. It is hoped that the members may occupy the new house early next winter. The building will be eight stories in height, absolutely fire-proof. The top floor will be lighted by skylights, and will be divided into a number of rooms for members of the club, who are interested in experimenting in problems of automobile construction and engineering. The main clubrooms, assembly hall and library will be on the second floor. Special provision will be made for the charging of electric automobiles.

POWER IN IDAHO.—In April, 1902, Mr. L. L. Nunn, of the Telluride Power Company, made an appropriation of the flood waters of Bear River for power purposes. Later the Government intervened and a long delay occurred, pending the investigation as to the feasibility of the project as an irrigation scheme, the object of the Government being to furnish water to settlers. At that time the Government's engineers thought there were about 150,000 acres that might be reclaimed. Meanwhile, private companies built canals to supply so much land that only 60,000 acres remained, and the Government finally permitted its claim to lapse on the theory that it could not afford to go to such an expense for so small an area. It is now Mr. Nunn's intention to divert this water, which comes in a flood in the spring, by canals to North and Bear Lakes, using these lakes as reservoirs. Thence the water is conducted down the channel of Bear River to the point of the proposed power station, insuring a permanent flow all the year round. The water appropriated is estimated to generate 50,000 hp under a head of 500 ft. and 20,000 hp will be utilized this year. The generating station will be located about 45 miles north of Logan, Utah, and the equipment for the first two units has already been ordered. It is the intention of the company to transmit power to southern Idaho and northern Utah.

NATIONAL-INTERSTATE TELEPHONE ASSOCIATION.—The next convention of the National-Interstate Telephone Association will be held at the Auditorium Hotel, Chicago, Ill., June 26, 27 and 28, next. Mr. A. L. Têtu, Nashville, Tenn., is secretary of the Association.

AN ELECTRIC RAILWAY FOR CHINA.—Lim Dat, a wealthy Chinese merchant of Victoria, B. C., is interested with a number of his associates in a plan to build an interurban electric railway from Canton to Sanwu, China. The city of Canton has a population of 2,000,000 and Sanwu has 500,000 residents. At the present time the service between the cities is an antiquated junk line on the River Sanwu, a distance of about 90 miles. These junks are towed by a launch and carry both passengers and freight. The trip takes about 14 hours. Each of the junks, however, carries about 200 passengers. The electric service to be initiated will make the trip a matter of only three hours, and will reduce the cost very considerably. Lim Dat intends to utilize a stream from the Quaitongshun Mountains for hydro-electric power.

MADISON BRANCH, A. I. E. E.—The March meeting of the Madison, Wis., branch of the Institute was held on Thursday evening, March 15, at the hall of the H. L. Doherty Club and the subjects of "Telephone Engineering" and "Aereal Cable Construction for Telephone Exchanges" were discussed by the members present. Mr. J. B. Kommers abstracted Mr. Carty's paper on "Telephone Engineering," and Mr. C. W. Burkett presented a very excellent paper on "Aerial Cable Construction for Telephone Exchanges." At the conclusion of his paper, Mr. Burkett showed a series of lantern slides comparing the old methods of open wiring previously employed with the much neater and more permanent construction with the use of cables. The meeting was very well attended and the subjects were extensively discussed. A short social meeting followed the reading and discussion of the papers.

HIGH-VOLTAGE EXPERIMENTS.—Some important experiments are being made at the Thury Works in Geneva, Switzerland, on high-voltage transmission by direct current. The experiments indicate that the use of 100,000 volts direct current is entirely practicable, and that by connecting the neutral point of the generating machine to earth at the station a voltage of 200,000 between the wires of a transmission circuit is practicable. The experiments have also shown that in underground cables a direct-current voltage may be employed more than twice as large as with alternating currents. For example, a cable pierced at a voltage of 30,000 alternating current was found to withstand between 70,000 and 80,000 volts direct current. In the experiment alternating currents of perfect sine wave form were used and there were no resonance effects, which latter would still further militate against the alternating current.

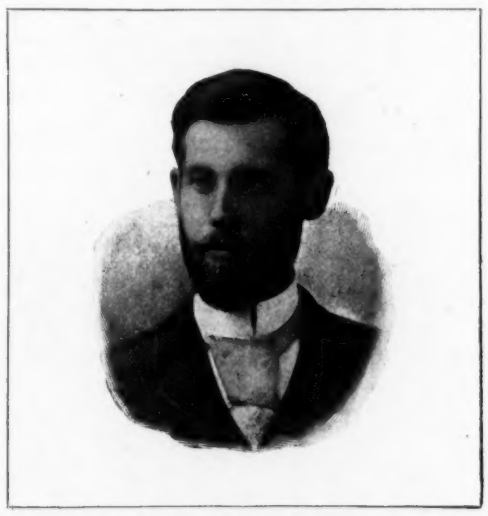
Dr. Thaddeus Cahill.

Thaddeus Cahill, the inventor of the beautiful electric-music system, described in the Electrical World of March 10, 1906, was born in the State of Iowa in 1867, the son of a physician, and was educated at Oberlin in the Western Reserve of Ohio, a village noted for its happy blending of Puritan earnestness and modern culture, and the seat of an endowed conservatory of music that is one of the best in the United States. He acquired the rudiments of an English education and of Latin and Greek under private tutors, entered the Oberlin High School in 1883, and graduated in 1884, the youngest member in his class and at the head of it. The next year he studied in the Oberlin Academy, but an active spirit and the desire to perfect certain inventions in which he was interested led him to break away from the routine of college to have more time for inventive work. He was then interested in certain musical experiments and inventions, from which the electric-music system has grown, and also in certain plans to increase the output of the typewriter and to reduce the labor and fatigue of operating it.

From 1885 to 1888 he divided his time between inventive work, in which his father and brothers generously encouraged and assisted him, and college studies under private tutors. To find leisure and means for his studies, he obtained a clerkship at Washington in 1889, with a member of Congress, the late Amos J. Cummings. First as private secretary to Mr. Cummings, then as clerk of the Committee on the Library of Congress, and later as stationery clerk of the House of Representatives, the young inventor found leisure both for legal studies and for inventive work, which during this period consisted partly in the making of models and experiments, but chiefly in the making and remaking of one elaborate set of drawings after another.

On going to Washington, in 1889, Mr. Cahill began to read law, and in 1892 he graduated from the Columbian (now George Washington) University Law School, where he stood third in a class of more than 100, and was one of five to receive honorable mention from the law school faculty, of which Judges Harlan and Brewer, of the United States Supreme Court, and Judge Cox, of the Supreme Court of the District, were members. In 1893 he received the degree of LL.M. In 1894 he was admitted to the bar. In 1900 he received the degree of D.C.L. for legal studies from the Columbian University.

During his school days in Ohio the physics of music and the



DR. THADDEUS CAHILL.

defects of existing musical instruments had engaged his attention. He made many experiments with a view to the production of music electrically, but without achieving entirely satisfactory results. In Washington, as noted, he gathered together the tangled threads of the electric-music plans, which had occupied him in boyhood, and became convinced that music by electricity, to be generated with the most beautiful chords and perfect expression, by living performers at a central station, and distributed therefrom to the homes of the people, over a wide area, was a practicable thing, which he could carry out. Another invention upon which he worked was the electrical typewriter, bearing his name. For several years he carried on both lines of investigation in parallel.

His first "telharmonium," submitted to Lord Kelvin in 1902, though less perfect than subsequent ones, and from the number of generators limited to music of a simple character, produced such beautiful effects as to impress every one who heard it. In 1902 Dr. Cahill established a larger laboratory at Holyoke on the Connecticut River, under the superintendency of his brother, Arthur T. Cahill, where his work has since been carried on. In 1903 he removed his Washington laboratory to Holyoke, and commenced the construction of a large commercial plant, for lease to the New England Electric Music Company, of which Mr. F. C. Todd is president. This plant is substantially complete, while a second large plant is well under way for installation by Mr. Oscar T. Crosby in New York City.

Electrical Equipment of Wanamaker's New York Store.

THE new building erected by John Wanamaker in New York to accommodate some of the departments of his store already established at Broadway, Fourth Avenue, Ninth and Tenth Streets, is a fourteen-story steel-cage structure of the most modern type and occupies the square block south of the older building. The new store embodies in its design the highest development of mechanical and electrical equipment as applied to the requirements of department-store service. The installation provides for the generation of electricity upon a large scale for lighting and for motors, and also for the heating, ventilating and mechanical service of both the old and new buildings.

GENERATING EQUIPMENT.

The power plant occupies the sub-basement which is divided into four sections; one section is devoted to the boilers and boiler auxiliaries, another section is given over to the electrical generating apparatus and hydraulic elevator pumps, a third section is occupied by ventilating equipment, and the fourth section contains the house pumps, air compressors, refrigerating equipment, filters and auxiliary apparatus.

Steam is generated in eight 300-hp Babcock & Wilcox boilers arranged in four batteries. Passageways are provided between the batteries, and an 8-ft. area in the rear contains the blow-off tank and piping together with the bilge pumps and other auxiliaries. A large firing space is provided in front of the boilers with two industrial railway tracks for coal and ash cars. Coal is stored in a 300-ton pocket beneath the Fourth Avenue sidewalk, from which direct delivery is made to the narrow-gauge cars. Feed-water piping and pumps are in duplicate, city water being used and preheated in Webster open feed-water heaters.

Fig. 1 is a view of the engine room showing some of the generator units. The equipment consists of six 300-kw generators

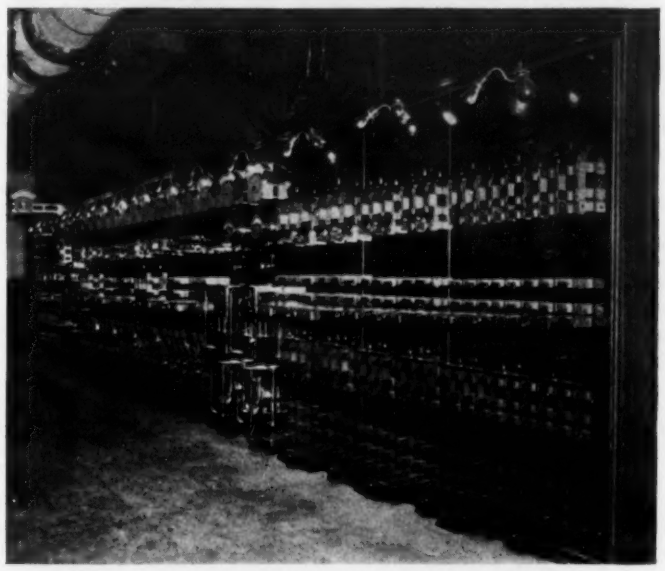


FIG. 2.—SWITCHBOARD, NEW YORK WANAMAKER STORE.

each of which is direct-connected to a horizontal cross-compound Buckeye engine operating non-condensing under a steam pressure of 150 lbs. The engines are provided with a gravity oiling system, a force-feed cylinder lubrication, a combined telescopic crosshead oiler and indicator reducing motion; but owing to the lack of space the tail rods usual in this type of en-

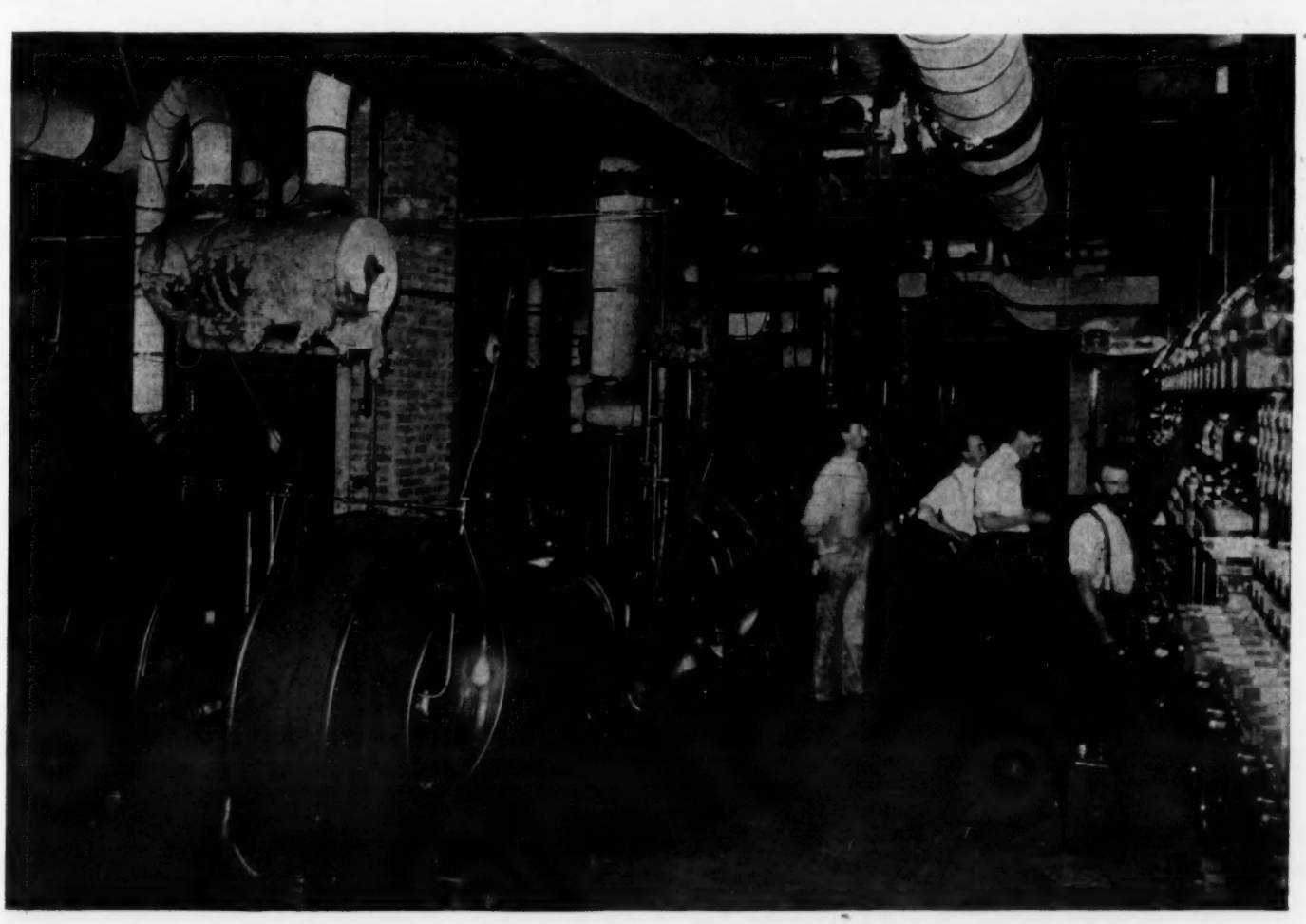


FIG. 1.—ENGINE ROOM OF THE NEW YORK WANAMAKER STORE.

gine were omitted. The engines are mounted together with their generators upon heavy cast-iron sub-bases which completely tie the high and low-pressure side together and also furnish support for the generators. Because of the many columns in the basement it was necessary to arrange the engines so that one of these columns would come between the cylinders which also necessitated a change in the position of the receiver. The exhaust steam from the engine and all auxiliaries is utilized for heating the buildings and also the hot water supply.

The electric generating equipment consists of six 300-kw direct-current, three-wire Westinghouse generators delivering current at an e.m.f. of 230 volts. The ratings of these machines provide for 25 per cent overloads almost continuously and 50 per cent overloads for at least two hours without excessive overheating. The neutral of the three-wire system is taken from auto-transformers back of the switchboard which are supplied from slip rings on the armature. The transformers are of small capacity, being designed for only a limited unbalanced load upon the system which has been very carefully planned for ease of balancing.

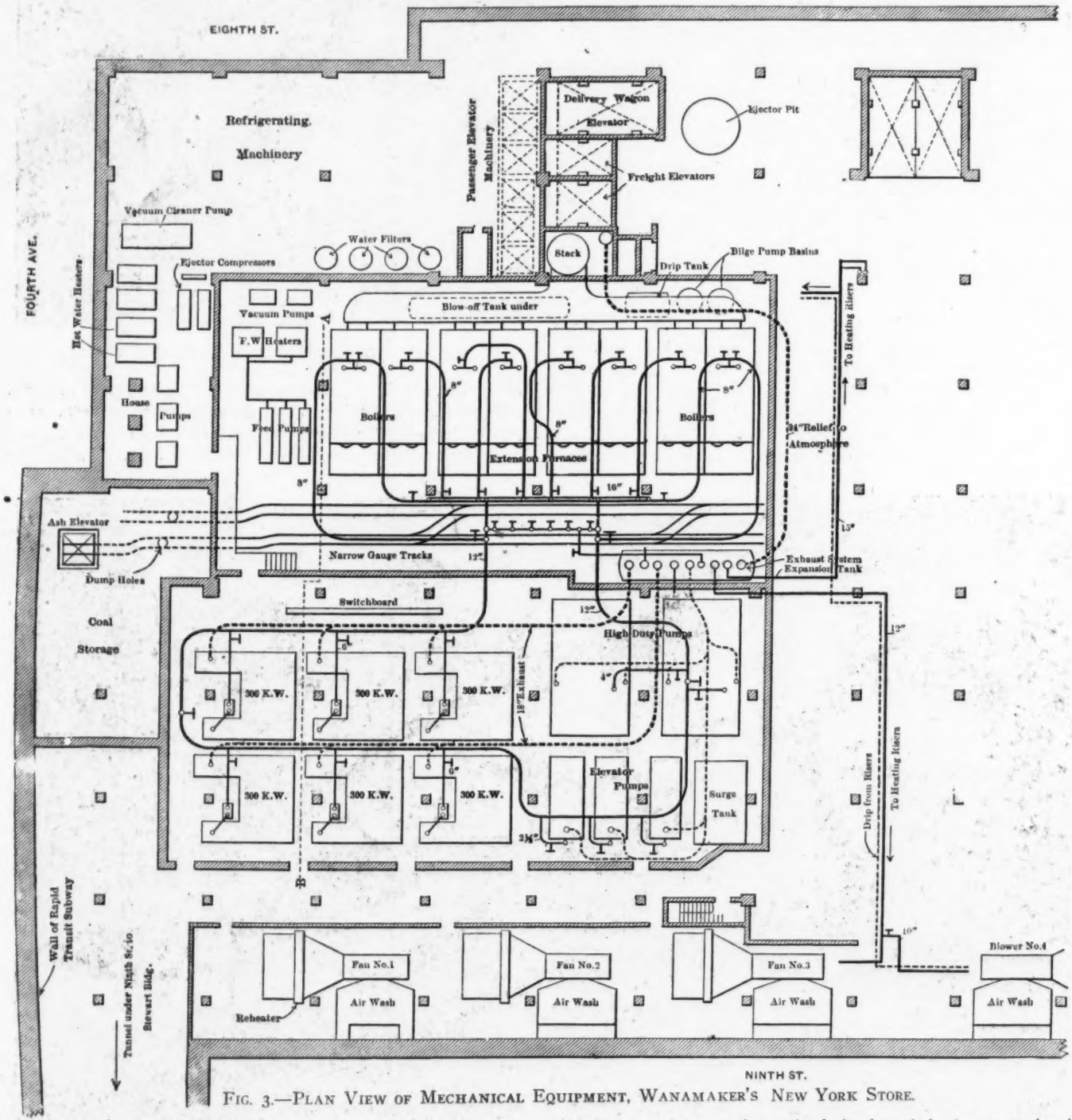


Fig. 3.—Plan View of Mechanical Equipment, Wanamaker's New York Store.

DISTRIBUTION SYSTEM.

The distributing system involves many interesting features and embraces radical departures in the arrangement of conduits, risers and panel-boards. The switchboard controlling the generator and distribution circuits is shown by Fig. 2 herewith. This is made up of fourteen panels of which six are devoted to the generators, two are totalizing, and the remaining six panels are for feeder circuits. Of these the three in the foreground control the feeders for the lighting system only, while the three at the opposite end of the board feed motor circuits. Each generator panel is equipped with two ammeters, a field rheostat handle, a voltmeter plug, a four-pole main switch and a four-pole "reversite" circuit breaker. Two voltmeters are swung from one end of the board in the usual manner, one of which is permanently connected to the bus-bars, while the other may be cut in on the leads of any generator by the usual switch. The totalizing panel at the left of the generator section is for the motor circuits, and is equipped with two voltmeters, an ammeter, a recording watt-hour meter and testing

equipment consisting of an ammeter, recording watt-hour meter and a selector switch for the voltmeter. The totalizing panel to the right of the generator section is for lighting circuits and

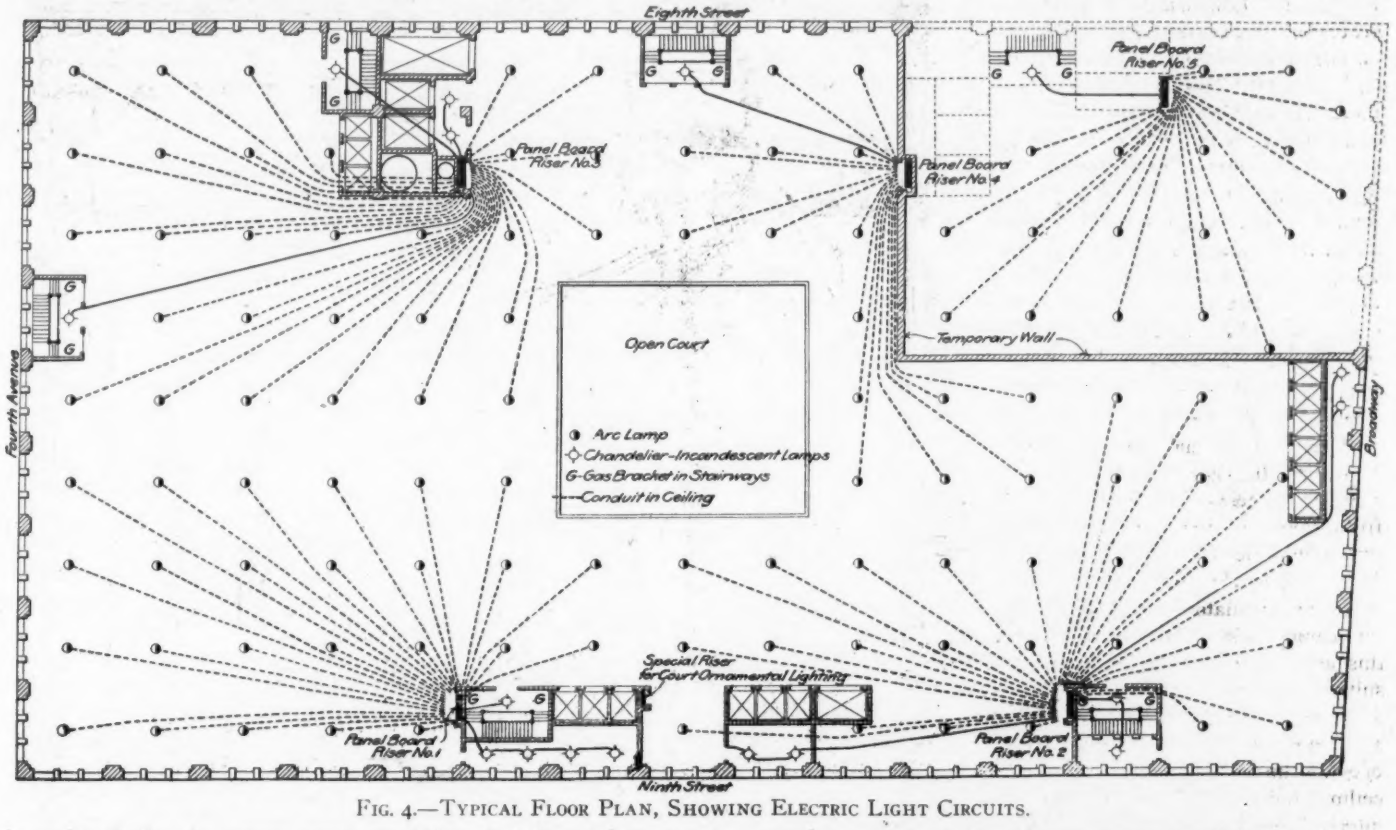


FIG. 4.—TYPICAL FLOOR PLAN, SHOWING ELECTRIC LIGHT CIRCUITS.

is equipped like the power panel, excepting that the equipment is in duplicate because the lights are fed from a three-wire system while the motor circuits are two-wire.

The power feeder panels control 31 motor circuits, four of which are in reserve and one is a large trunk feeder leading across the street through a tunnel to the older building. The lighting feeder panels control 14 three-wire feeder circuits, two of which are trunk feeders to the building across the street. Reference to the engraving will show that the switches on the board are in duplicate; one set being used for testing purposes. Each switch has immediately below it a switch of

FIG. 5.—LIGHTING IN PIANO ROOM.

the same capacity which is connected with the testing equipment on the totalizing panel. By closing this switch and opening the regular feeder switch the power consumption of that part of the building fed through the feeder may be ascertained.

The entire ventilating outfit is driven by direct-current motors through Morse chains, the motors ranging in size from 5 hp to 60 hp and totaling over 400 hp. With the exception of the elevator and feed-water pumps, all the pumps in the establishment are motor-driven; these include bilge pumps, compressors for sewage ejectors, house pumps supplying fresh water to tanks on the roof, pumps in the refrigerating room and pumps for the vacuum system for cleaning carpets, etc. Some of

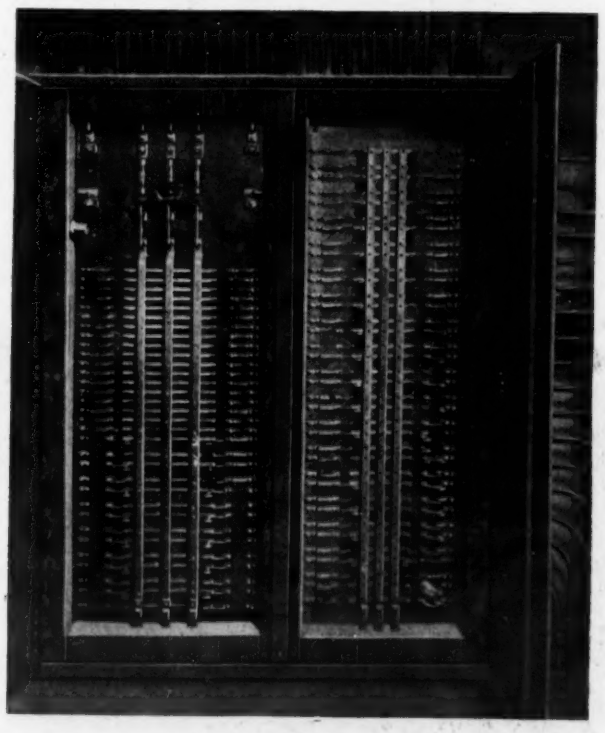


FIG. 6.—VIEW OF ONE OF THE LARGE PANEL BOARDS.

these motor-driven pumps are shown in the accompanying engravings.

The building is divided electrically into five sections, four sections being at present in use. Each section has two centers of distribution, one below the first floor level and the other below the ninth floor level; the former supplies all the panelboards in

its particular section from the sub-basement to the second floor, while the latter supplies the panelboards from the third floor to the attic. Sub-feeders extend upwards and downwards from these centers of distribution to panel boxes on each floor, which control the local circuits. The feeders rise to their respective panels in special shafts, which are in reality closets extending from floor to floor, the feeders passing through the floors in the usual manner. The panelboard itself is fastened to angle-iron supports extending from the floor to the ceiling above, and is encased in a sheet-steel casing, as shown in Fig. 6 herewith. This casing, together with the feeders and conduit, is located within a spacious closet with double hinged doors. The feeders are enclosed in conduit only where they pass through the concrete floor, being run as open work from floor to floor, the angle-iron supporting the panel-box also acting as a support for iron strips which hold the insulators through which the cables pass. The advantage of this arrangement, aside from the resultant economy, is that the entire panelboard and its connecting circuits are rendered easily accessible, being entirely unconcealed from floor to ceiling, and this without affecting the interior finish of the store. These risers are in all cases of heavy insulated cable 500,000 cir. mils to 1,000,000 cir. mils in area; sub-feeders range from 400,000 cir. mils to 500,000 cir. mils in area. The layout permits a maximum drop of five volts volts from the switchboard to the farthest outlet; the maximum allowable feeder drop being three volts, while the drop in banch circuits does not exceed two volts. It is thus possible with a generator voltage of 230 on a three-wire system to use 110-volt lamps in the farthest outlet.

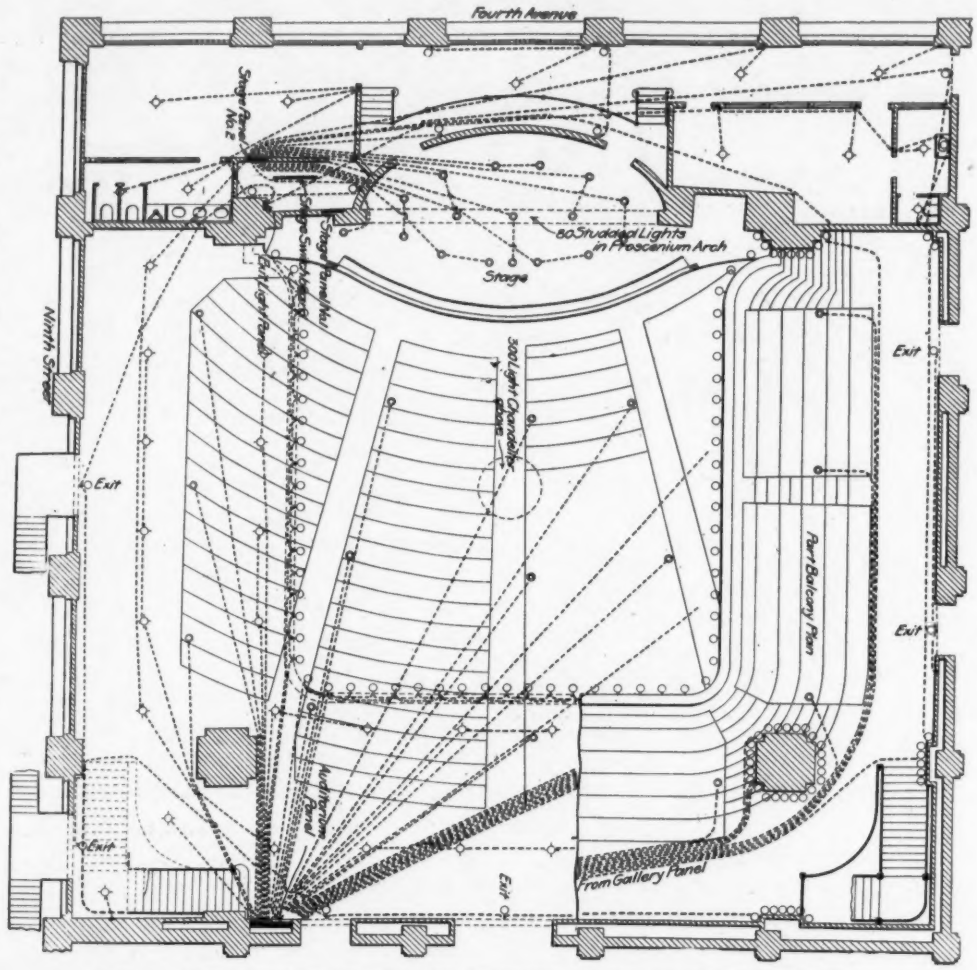


FIG. 9.—PLAN VIEW OF MUSIC HALL, SHOWING LAYOUT OF ELECTRIC CIRCUITS.

ARC AND INCANDESCENT LIGHTING.

The greater part of the general store illumination is furnished by arc lamps. These are spaced about 20 ft. apart in all directions, from 15 to 25 arc lamps being controlled from each panelboard in the riser closets. There are about 750 arc lamps at present installed; but these are confined to certain floors, there being no arc lighting on the second, third, fifth, sixth, seventh and ninth floors. When the building is complete there will be over 1,400 arc lamp outlets available. Each arc lamp is entirely independent of the other, being fed from a separate circuit from the panel, and controlled through an individual knife switch and enclosed fuse on the panelboard. The individual circuits average 60 to 70 ft., the longest being 120 ft.; they are wired with No. 12 and No. 14 wire, depending on the length of the circuit. The arc lamps are placed midway between building columns and 10 to

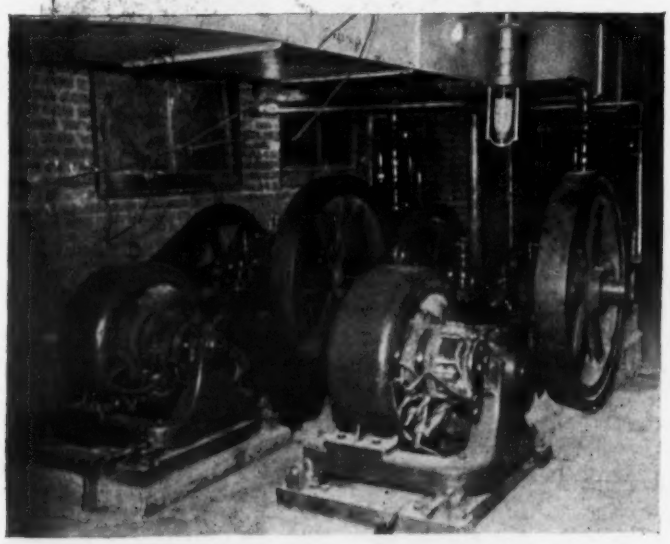


FIG. 7.—AUTOMATIC MOTOR-DRIVEN AIR COMPRESSORS.

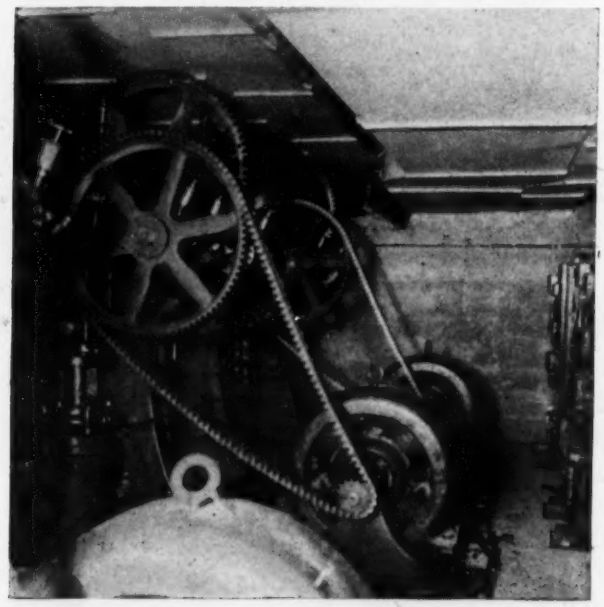


FIG. 8.—MOTOR-DRIVEN HOUSE PUMPS.

12 ft. above the floor. The lamps used operate at 115 volts and at 6.6 amp. have 1,200 nominal candle-power. The lamps are of Stanley-G. I. make and are of the enclosed type.

Incandescent electric lighting is depended on entirely on many floors, and is also used to supplement the arc lamps on other floors. In the sub-basement incandescent lighting is used very largely, 240 outlets being provided, while in the show windows both on the street and in the Rapid Transit Subway station, in the art gallery and in the music hall, concentrated lights are used with special Frink reflectors. In the piano show rooms on the second floor and also in the model house and the music hall, studded ceiling lights are extensively used, almost 800 outlets having been provided for this purpose. The chandelier lighting in one section of the piano room is shown by Fig. 5. It would appear from the engraving that the distribution of lights was not good, but this is not the case. The decorative color scheme in this section is of such a character that truthful photographic reproduction is impossible. The outlets in the conduit system number 4,824, of which 847 are for chandeliers, 297 for brackets, 777 for studded lamps, 494 for drop lights, 249 for attachment plug boxes and 222 for floor boxes, the remainder being used for switches, arc lamps, etc. All elevator shafts are provided with plug sockets at every floor in order to facilitate shaft lighting for mechanics at work in the shafts.

The general riser system is supplemented by a separate riser group for the ornamental lighting in the open court in the center of the building. Panelboards are installed at every third floor, which control branches to the intervening floors. There are no lights in the court, however, above the eighth floor, an ornamental skylight spanning the court at this point.

EXHIBITION OF RESIDENCE ILLUMINATION.

An innovation in department store equipment has been made in the Wanamaker store by the addition of a music hall having a seating capacity of 1,200 persons, and a model house. The latter is a typical two-story suburban dwelling erected within the building at the Fourth Avenue and Ninth Street corner of the sixth and seventh floors, occupying a space about 85 ft. square. Eighteen rooms are provided in the house, which will be used for exhibition purposes to demonstrate methods of furnishing and suggestions for furniture designs and interior decorations to harmonize. Fig. 10 shows the first floor plan of this model house, including the layout of the wiring and conduit for lighting. The Louis XV salon has a domed ceiling oblong in shape, around the edge of which is a row of 28 studded lights to heighten the artistic effect of the decorated ceiling. The room is also provided with five chandeliers and four two-outlet brackets, the center chandelier having nine lights and the others four lights each. The switches controlling the lights are placed near the door. In the dining-room a very pleasing effect is obtained by an arched ceiling having 40 studded lights and a four-light chandelier in the center. In addition three two-light brackets are provided at the sides and a floor outlet in the center of the room for a table candelabrum. The garden has a vined trellis around the four sides and a fountain in the center. Two rows of studded lights are placed in troughs fixed to the trellis work and special reflectors throw the light upwards, giving a soft moonlight effect. In addition there are 44 drop lights under the trellis for Chinese lantern effects.

The lights in the model house are controlled from a centrally-located panelboard in the hall, from which lead 42 circuits for the first floor and 15 circuits for the second floor. The lights are in almost all cases controlled from local switches, and six-light receptacles are provided for decorative light connections. Additional circuits other than those shown in the plan have also been provided for future decorative lighting schemes, and these are controlled from an auxiliary panel located beneath the stairway on the first floor. The model house panels are supplied by three 300,000-cir.-mil feeders from the No. 1 group of risers.

The lighting circuits in the music hall are shown in Fig. 9. In the center of the ceiling is a 300-light chandelier, while a row of 80 studded lights is arranged on the proscenium arch, and a row of 60 bracket lights skirts the inner edge of the balcony. The stage is lighted by a row of 80 footlights. There are, in addition, a large number of bracket lights and small chandeliers for lighting the sides and rear of the auditorium and balcony, a large number of studded lights over the rear of the balcony, and floor outlets in all parts of the auditorium floor and balcony for special lighting. In the right wing of the stage

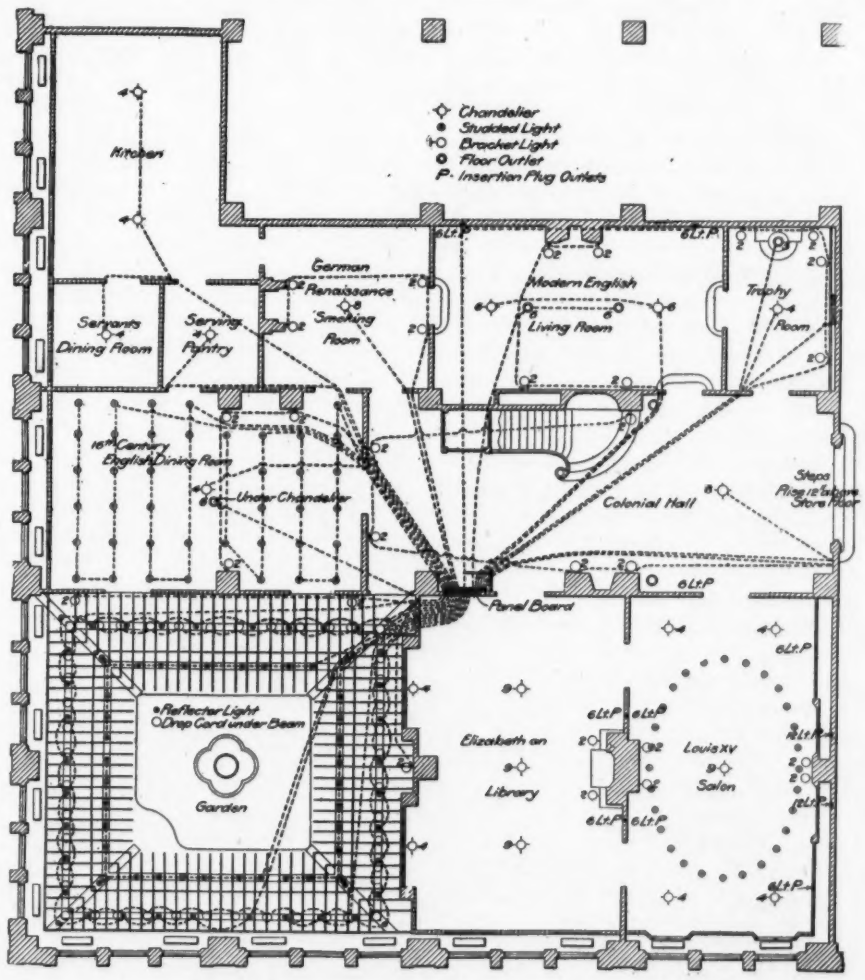


FIG. 10.—PLAN VIEW OF FIRST FLOOR OF MODEL HOUSE, SHOWING LIGHTS AND LIGHTING CIRCUITS.

are two panelboards which control all the purely theatrical lighting; standard dimmers controlling the lighting intensity of the footlights, proscenium arch, large chandelier and floor outlets on the stage, the auditorium lighting being controlled from the rear of the auditorium. A special panel is devoted to the lighting of the exits, the exit lighting circuits being installed independent of the other panels. In this respect the lighting of the music hall conforms to regular theatre practice, exit lights being installed at the 12 exits to the fire escapes and store proper.

The chandelier is wired for 24 circuits, each consisting of three No. 6 wires in conduit. The footlights and proscenium arch lights are fed from two circuits. The panels in the auditorium and balcony control 58 three-wire circuits, the general arrangements of which are indicated in the drawing. The pipe organ installed in the spaces on either side of the stage has a 15-hp motor to operate it and the echo organ is equipped with a 2-hp

motor. Fresh air is supplied to the auditorium by a 30-hp motor-driven fan, while the vitiated air is pumped out by an exhaust fan driven by a 20-hp motor. Thus it will be seen that ample provision is made to insure an adequate supply of fresh air, and the removal of the foul air, which is so essential in a hall of this character.

TELEPHONE AND SIGNALING WIRING.

An interesting arrangement of conduits has been installed on all floors for bell, telephone and signal wires. Three lines of 1¼-in. galvanized-iron pipe are laid under the floor from the riser shafts and encircle the floor in such manner that all parts of the floor are within short range of the outlet points. Connection boxes are installed at intervals of 40 to 50 ft., into which the three lines of conduit are bushed. These boxes are of pressed steel 18 in. square and have tight-fitting brass cover plates flush with the surface of the finished floor. Service outlets through which connections are extended to telephones, bells, etc., are located approximately 10 ft. apart throughout the entire system. From these outlet tees and the vacant sides of the connection boxes, wires are fished under the floor to any desired point. The tees in the conduit lines are entirely concealed beneath the floor, but are accessible through removable sections of the flooring above them held by two screws. The tees are normally plugged, but are fitted with outlet bushings when connections are to be made through them.

The connections for these low-voltage circuits are made through 2-in. conduit risers located in the same closets with the lighting risers. These auxiliary risers are provided with special interconnected panels at every floor through which branch connections to the under-floor conduit systems are easily made. The interchanging of connections may also be easily accomplished at these panels, which are also valuable for making tests of the various systems.

All telephone lines within the building are run in conduit, as well as all bell and signal wiring, watchman's time detector circuits and fire alarm signal systems. Additional low-voltage circuits may be added at any time and for any purpose whatever with a minimum of trouble.

The wiring in the building is installed in extra heavy loricated conduit, of which over 75 miles is in use. The switch and panelboards, some of the latter controlling over 60 circuits, were supplied by the H. Krantz Mfg. Co., of Brooklyn, N. Y. Bossert outlet boxes are used and Hart switches and baseboard plugs, the floor outlets being of Stanley-G. I. make. The architects and engineers of the building were D. H. Burnham & Co., of Chicago, and the Thompson-Starrett Co., of New York, was the contractor for the entire electrical installation.

Polonium Rays.

Thomson and Rutherford suspected that polonium rays, although they produce a positive charge by their impact, do not consist of purely positive particles, and Rutherford estimated that for every four α particles emitted one electron was also emitted by polonium, thus reducing their apparent positive charge. Soddy also supposed that both positive and negative corpuscles are generated by the impact upon the gas of neutral particles, which alone, he maintained, are emitted by the polonium. In order to test these questions P. Ewers has adopted a new apparatus which is described in *Physikalische Zeitschrift*. The apparatus consisted of a copper disc coated with polonium and surmounted by a nest of small copper boxes serving as diaphragms, and enabling the observer to control the path of the particles shot out from the polonium. The boxes had such dimensions that no particle could reach the upper plate unless it were projected at an angle of at least 55° to the lower plate. By employing magnetic and electric fields of different strengths he was enabled to prove that the negative particles are the slowly-moving electrons discovered by J. J. Thomson. He does not agree with Soddy and Bragg that the positive charges are acquired by collision, since higher potential gradients fail to increase the ionization of the residual gas.

Central Station Notes from Madison, Wis.

MADISON, WIS., has always been a place of unusual interest to central station men on account of its lighting plant occupying the position of a kind of school in which young men are educated in the practical part of the business for service in the other plants controlled by the American Light & Traction Company.

Madison is a rapidly growing city, having had in 1900 a population of 19,164, and according to the school census a population of 24,301 in 1905. The company has connected the equivalent of about 50,000 incandescent lamps of 16 cp. This includes the numerous Nernst lamps used for store lighting. The connected horse-power in motors is about 1,000.

USE OF NERNST LAMPS.

One of the first things that strikes the visiting central station man at Madison is the unusual number of Nernst lamps in use. These have been advocated exclusively by the company as giving better resuits in useful illumination than the alternating-current arc. At present writing there are 463 Nernst lamps connected. The three-glower size is the most common. It has been found that the cost of maintenance of these three-glower lamps, including labor and material, is about .75 cent per kw-hour. The maintenance of single-glower lamps is considerably higher, being over 1 cent. These Nernst lamps are inspected by a man who also brings in customers' meters for testing. He brings in the Nernst lamps whenever repairs or renewals of glowers are needed, substituting another lamp in the place of the one removed. The lamps when brought in are repaired by the man engaged in testing customers' meters.

FLAT RATE SIGN AND DISPLAY LIGHTING.

Another point which cannot fail to impress a visitor to Madison who is familiar with the usual appearance of down-town streets at night in a city of this size is that there is an unusual amount of sign and decorative lighting as well as show window lighting. The company has connected the equivalent of 4,279 16-cp lamps for this class of work. This sign lighting is taken at a flat rate of so much per year. This flat rate is equal to what the bills would be if the energy was sold according to meter on the Doherty system of charging used in Madison. These flat-rate lamps are turned on and off by the company's patrolmen and burn an average of six hours each night. The following figures are used in calculating the schedule of rates for this kind of work:

A readiness-to-serve charge of 15 cents per month or $1.80 per year per 16-cp lamp or its equivalent is first made. To this is added $12 per year or $1 per month for service charge to cover the expenses of the patrolmen, bookkeeping, etc. The amount of energy that will be consumed at 6 cents per kw-hour burning six hours per night is then caculated and added to the foregoing charges.

The effect of the campaign for this kind of contracts is made very apparent by the load curve for a typical day in December, 1903, as compared with December, 1904. At 7.45 p.m. in December, 1903, which was immediately after the evening peak, the load was 400 kw. The same hour in December, 1904, the load was 700 kw. The Doherty system of flat rate contracts for sign and display lighting was inaugurated at Madison in the summer of 1904.

POWER PRODUCTION.

The company owns two plants. The old plant is notable for its economy and the new plant for the collection of new prime-movers contained therein. The old plant is equipped with two Hazleton upright "porcupine" boilers of 300 hp each and one Stirling water-tube boiler of 300 hp. It is located so as to secure condensing water from the lake and coal from a railroad siding. The engine equipment consists of Russell medium speed compound condensing engines of various sizes, most of which are belted to generators. There is one large direct-connected, alternating-current generator. This was one of the first plants to adopt the monocyclic alternating-current system, and some of the generators are of this type, being operated in parallel with

three-phase apparatus. The lighting service is supplied by 2,300-volt primary, 60-cycle alternating current, and the power service by 500-volt direct current, necessitating the operation of two classes of generating machinery continuously.

This plant is a good illustration of the fact that it is not necessarily the newest and most ornamental station that makes the best showing in economy. While it is a substantially constructed and well-maintained station, many engineers would doubtless turn up their noses at the belted machinery and various other not altogether up-to-date features, until they learn that it holds the best record for economy of any of the electric power plants controlled by the American Light & Traction Company. This plant produces a kilowatt-hour with an average consumption of 5 lb. of Youghiogheny coal. This coal contains about 13,000 B.t.u. per pound. While this may not be a remarkable record for a large power plant with large, extremely economical units, it must be remembered that this is a plant of medium or even small size, and that the units are many of them belted and of various small sizes. The secret of the good record is undoubtedly due to the close watch which is kept on station economy. A combination of engines can always be found which will nearly fit the load, so that engines do not have to be run greatly underloaded. Three firemen are employed in this plant, each working a 10-hour shift, so that shifts overlap part of the day. All coal is brought out from the storage bin and weighed by the firemen before being used under the boilers.

The new plant is in a fine fire-proof structure adjoining the company's gas works. It contains three Westinghouse gas engines and a Westinghouse-Parsons steam turbine. These gas engines run on unpurified coal gas. They are of the three-cylinder type, two of them being of 280 hp each and one of 125 hp. They have been in operation about four years. They are used for operating railway generators, as the company sells energy for operating the street railways in Madison. The railway generators are operated in parallel with a 240-amp.-hour storage battery. These gas engines are excellent for responding quickly to emergencies. It has been repeatedly demonstrated that a gas engine can be started and have its generator carrying load in one minute. This is not a show performance, as on a number of occasions, when it has been necessary to shut down one of the engines quickly, another one has been started up to take its load without interrupting the railway service.

The Westinghouse-Parsons steam turbine was installed November, 1904. Tests have shown its steam consumption, including the dry vacuum pumps and the belted feed pump, to be 27.8 lb. of steam per kw-hour at three-quarters load. In actual service the consumption of coal per kw-hour is 4.54 lb. It is rarely worked below three-quarters load as it is employed as a peak load unit. The rest of the load is carried by the old station. The turbine runs an average of six hours per day. It is of 400 kw capacity, operating at 3,600 r.p.m. A device has been installed on this turbine by Mr. F. M. Richards, superintendent of manufacture for the company, which is designed to prevent accidents due to the failure of the oil pump. The float valve in the oil pump gives warning if the proper oil level is not maintained, so that the attendant can immediately start an auxiliary oil pump. The boiler plant supplying this steam turbine consists of two Wicks boilers, each of 300 hp. Only one fireman is needed at this plant, and he weighs all coal.

DISTRIBUTION.

The power distribution circuits are all 500-volt, direct current. No attempt is made to do much motor work off of the alternating lighting feeders. The lighting distribution is by means of single-phase circuits from three-phase bus-bars. All energy is metered at the station and at the consumer's service switch, except that no meters are used in flat-rate sign and display lighting, the consumption of which is known. The extent to which customers have been grouped on large transformers can be seen when it is stated that there are only 50 transformers connected. The standard sizes used are 10 and 15 kw capacity, although there are two large transformers of 50 kw capacity.

In the downtown district all of the secondary mains are connected together through the medium of fuses. Each section of secondary main is supplied by one transformer. In case the fuses blow on a transformer, it will not overload and blow the fuses on neighboring transformers, thus causing the spread of trouble. The fuses used between secondary sections are of the enclosed type. Transformer primary circuits are fused with D. & W. enclosed fuses. In the down-town district these section fuses are inspected about once a week, and the load on the transformer during the peak is measured to prevent overloading some transformers and underloading others, as is likely to occur where frequent measurements are not taken and a number of transformers are feeding into the same secondary network. This practice originated at Denver and was described by C. W. Humphrey, chief engineer of the Denver Gas & Electric Company, in a paper before the National Electric Light Convention in 1904. The secondary distribution is on the three-wire system. The neutral wire is not fused.

The neutral has not been grounded in the past, but the company is proceeding to do so as fast as possible. This will be done by means of buried copper plates in the manner indicated in the National Electrical Code. This is done in the interests of safety of life and property and to prevent dangerous voltages accidentally existing on secondary low-tension circuits. The company is troubled very little from crosses with other lines, because most of the primary feeders are on a high pole line far above the other wires on the streets, so that the falling of telegraph and telephone wires does not cause trouble to the light and power service. The company keeps a number of large maps, one for each class of distribution. Thus one map shows the primary feeders, another map shows the secondary mains, another the 500-volt power distribution and another the arc circuits.

The company has about 2,500 consumers' meters in its electrical department. To test these meters and inspect and maintain Nernst lamps two men are required, one for outside work to bring in meters and lamps, and another who does nothing but test and repair work. Meters are brought in for testing purposes about once in two years. Meters are mainly Westinghouse and high-torque General Electric types. It is considered that with modern meters this is a sufficiently frequent test.

The company charges $4.50 for making a service connection. In outlying districts, where a customer wishes service who is beyond the company's lines, extension will be made for him upon payment of the cost of the extension, and as new customers are added this amount will be rebated to the first customer. The company's position is that it is not in the real estate speculation business, and that the customer should assume risks incident to extending into places, the growth of which is uncertain.

NEW BUSINESS DEPARTMENT.

In common with other American Light & Traction Company properties, this company has a very active new business department, started in May, 1904. From that time until October, 1905, three men were employed in this department. Two men were then added, making five in all. More attention is given to pushing the gas business than the electric, although one-half of the solicitors' time is charged to the electrical department. About 95 per cent of the company's gas output is used for heating purposes, which goes to show how little legitimate competition there is between gas and electricity. The results produced by the new business department in securing sign and display lighting have been described in the paragraph devoted to that subject. in which it is shown that an enormous increase in the evening load after peak hours was made as a result of the first six months' work.

A clever bit of advertising was devised by Mr. George Williams, manager of the new business department, just before the holidays. He had photographs taken at night of 36 stores in Madison which had fine outside or inside electrical displays. Half-tone engravings were made from these and printed on a single sheet as a poster. In the middle of the sheet were the words:

"Snap shots of every-night illuminations in Madison, the ideal shopping center of Wisconsin. Christmas shopping has already begun in Madison. Madison stores are renowned for their reliability and select assortments; in fact you get more actual value and satisfaction from purchases made in Madison than is possible in most larger cities in the country."

These posters were furnished free to whatever merchants in Madison wished to send them to their customers in the surrounding country. It was a good advertisement for the merchants and indirectly an excellent advertisement for electrical display and was something to set the unprogressive merchant to thinking whether he had not better light up.

The system of paying solicitors in Madison was described by Mr. C. H. Williams in a discussion at the Northwestern Electrical Association and given in the February 3 issue of this journal, page 276. The solicitors received a fixed salary, plus a commission based on the amount and character of the business secured. A regular schedule has been made up for determining the number of points each class of business counts.

RATES.

The Doherty readiness-to-serve rate has supplanted the old system of rates for most of the long-hour business. Readiness-to-serve charges consist of 15 cents per month per 16-cp lamp, or its equivalent connected, plus $1 per month service charges, plus 6 cents per kw-hour for the energy consumed as measured by meter. This system of charging is especially favorable to long-hour customers. Those whose kw-hour consumption is low in proportion to the number of lamps connected, as in residences, find it cheaper to adhere to the old schedule, which is as follows:

Minimum bill, $1.00 per month.
16c. per kw-hour for consumption between 6,250 and 26,000 watt-hours.
14c. from 26,000 to 52,000 watt-hours.
13c. from 52,000 to 78,000 watt-hours.
10c. for 78,000 or more watt-hours.

The Doherty rate was put in effect quietly about four years ago. About 100 customers were taken on in a year on this contract without advertising it. After a year's trial, the company began to advertise it, with the result that most of the long-hour customers changed to the Doherty contract. The effect temporarily was to reduce the gross receipts, but in about a year, the change brought enough increased business to make up for the temporary set-back. The effect of the Doherty rate has been to keep down the number of lamps in a store and to encourage the longer use of the lamps installed. Thus, customers who had wired their stores for an enormous number of lamps, only a few of which were ordinarily used but which were turned on during the peak load, were influenced to cut down their connected load and increase the consumption of energy. This use of light a greater number of hours per day by certain merchants had its effect on other merchants on the same street, who were also obliged to light up evenings if they were to appear progressive.

The company furnishes free renewals of standard clear bulb lamps from 10 to 50 cp. The first installation of lamps must be paid for by the customer.

Mr. H. H. Scott is superintendent of the electrical department of this company, and John Corscot, a former mayor of Madison, is general manager.

New Type of Condenser.

A patent was issued March 13 to Prof. R. A. Fessenden to overcome the effect stated to exist in applying comparatively large metallic sheets to the surface of a dielectric, in which case it is practically impossible to prevent the formation of minute pockets between the metallic sheets and the dielectric, these pockets containing fluids which cannot be removed and the presence of which give rise to large losses. Several forms of condensers are described. In one small areas of tinfoil are applied to a plate of mica, the adjacent areas overlapping to a certain extent. In applying these areas to the dielectric, openings or spaces are left for the escape or removal of fluids, etc., and the edges of the coatings have an additional area of insulating material to prevent discharges from said edges. In another case the tinfoil is a single sheet containing numerous perforations, and in a third case the metallic coating is formed by flattening a sheet of wire gauze between rolls.

Single-Phase Equipment for the New York, New Haven & Hartford Railroad.

Our last issue contained a brief abstract of the paper presented by Mr. B. G. Lamme before the New York Railroad Club, and of the discussion which followed the reading of that paper. A few additional details are given below concerning the electric locomotive which was described by Mr. Lamme.

The novel features embodied in the electrical equipment of the locomotive reside in the multiple unit method of control, as was noted last week. The mechanical construction of the locomotive also presents several novel and interesting features which deserve special consideration.

Owing to the fact that the entire space between the wheels is

FIG. 1.—ARMATURE COMPLETE WITH QUILL.

occupied by the motors, it was impossible to transmit the draw-bar pull through the center line of the locomotive in the usual way. Instead of this, strong plate girders heavily cross-braced are carried outside of the wheels and the entire strain of the draw-bar is carried to these through strong box girders having top and bottom plates 42 in. wide. Directly underneath the girder at each end is a Westinghouse friction draft gear to which the draw-bar is attached. The entire design lends itself to a very strong construction without great weight. The cab is built up of sheet steel on a framework of "Z" bars. The apparatus inside the cab is carried on a framework of structural steel which is built into the cab and firmly anchored to floor and ceiling.

The frame and field of each motor are split horizontally and can be removed in halves in order to give access to the inside of

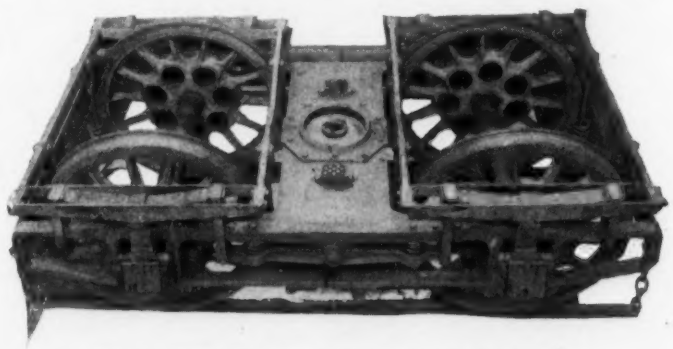


FIG. 2.—VIEW OF TRUCK WITH MOTORS REMOVED.

the field or to the armature. The armature is not placed directly on a shaft but is built up on a quill through which the car axle passes with about 5/8 in. clearance all around. On this quill, at each end, are placed bearings which carry the field frame.

At each end of the quill is a flange from which project seven round pins, parallel to the shaft, into corresponding pockets in the hub of the wheel (see Figs. 1 and 2). Around each pin is placed a coiled spring wound with the turns progressively eccentric. These springs are contained between two steel bushings, the smaller of which slips over the pin, and the larger fits in the pocket in the wheel. These springs are amply strong to carry the entire weight of the motor, but are normally required to transmit only the torque of the motor and to keep the motor axis

parallel to the axle. They allow a total vertical movement of about ¾ in. The end play of the motor, instead of coming directly on the wheels, is taken by strong coiled springs inside of the driving pins which press against covers in the outer ends of the spring pockets in the wheels. The torque on the motor frame is taken by heavy parallel rods which anchor the frame to the truck above and below the axle. These rods permit vertical or side motion of the motor, but prevent excessive bumping strains from coming on the motor driving springs. The entire weight of the motor is normally carried on springs supported from a steel frame surrounding the motor and resting on the journal boxes.

The frame, trucks and cab of this locomotive were built by the Baldwin Locomotive Company, on designs developed after many conferences between the New Haven Railroad Company, the Baldwin Locomotive Company and the Westinghouse Electric & Manufacturing Company. The design adopted was partially determined by the fact that the motor equipment must be suitable for use on both alternating and direct current. This to a certain extent controlled the number and size of the motors and thus affected the construction of the trucks and other parts. The results have turned out so well, however, that there is every reason to believe that this type of locomotive will be used in future even where alternating current alone is used.

The motors are internally of the same general type which the Westinghouse Company has been building for some time for interurban service. However, due to the relatively low speed of the motors, the maximum commutator speed is very low, being less than 3,000 ft. per minute when the locomotive is making 60 m.p.h. This may be compared with 5,000 to 7,000 ft. commutator speeds which are frequently attained in both direct-current and alternating-current, high-speed service with fairly large motors.

One interesting feature in these motors is the method of cooling. As a blower is used in the locomotive for cooling the lowering transformers it was decided to extend this method of cooling to the motors also. In the floor of the cab is an air conduit of considerable size from which air is piped to each motor. This method of cooling improves the continuous capacity of the motors so that the continuous rating is almost equal to the one hour rating. A further very great advantage in this method of cooling lies in the fact that the motors can be kept very clean in this manner, as the inside of the motor is kept under partial pressure at all times, tending to keep out dust and dirt, as all air flow is outward. The air furnished to the motor, being taken from the inside of the cab, can be kept relatively clean and dry.

On alternating current the motors are not operated in series parallel as on direct current, but are connected permanently in a given manner and the supply voltage is varied. This gives an equivalent of the series parallel, except that the number of efficient operating steps is much greater. There are six operative voltages, or running points, corresponding to six taps on the lowering transformer, while there are a small number of intermediate steps, which are used only in passing from one working point to another. The tests have shown that the acceleration on both alternating current and direct current is very smooth.

There is one feature in the direct-current control which is not generally found at the present time on direct-current equipments, namely, shunting the field coils for higher speeds. On the series position the motors have an efficient running point. It is usual railway practice to pass from the series to multiple position by the introduction of resistance, there being no intermediate efficient running speed. On the New Haven equipments, however, the type of motor used is one which permits an almost indefinite shunting of the coils without affecting the commutation or operation otherwise, and advantage is taken of this to obtain several higher speeds by shunting the field coils before passing into multiple. In this way several efficient running points are obtained between the series and the multiple positions.

When operated on direct current the current is fed directly to the motors. On alternating current, however, step-down transformers must be used as the trolley e.m.f. is 11,000 volts. The high-voltage trolley system is to be suspended from steel bridges, which span from four to six tracks normally, and which are placed at intervals of about 300 ft. The trolley wire is maintained in a practically horizontal position by means of a double catenary suspension in which triangular supports are placed about 10 ft. apart.

At points corresponding to anchor bridges, that is, about two miles apart, each trolley wire is broken by section insulators and is connected to the other trolley wires and to two feeder wires through automatic circuit-breakers. Otherwise each trolley wire, with its cables and supports, is insulated from the adjacent wires. In this way each wire is sectioned and a short-circuit on any one section can cut it out without putting the neighboring wires out of service. The two feeder wires just mentioned are carried the whole length of the alternating system, and by means of these and the arrangement of automatic switches, any entire section of four or more trolleys could be cut out of service and the sections beyond can be kept in service.

The high-voltage trolley will extend about 19 miles in one direction from the power house, and about three miles in the opposite direction to Stamford, and no transforming stations will be used on the part which is now to be installed.

In the main power house, which is located at Riverside, each of the generators is of the three-phase, steam-turbo type designed for 5,500 kw. These generators will at present be operated single-phase, in which case each is rated at 3,750 kw. As an illustration of the unusual conditions met with in the design of these 25-cycle machines, it is stated that a single complete armature coil weighs about 600 lb. However, as each machine has only two poles, the total number of armature coils is relatively small. As a machine in such service is liable to have short-circuits at times, the armature end windings are extremely well braced. As these machines are to feed directly into the trolley system, they are wound for the normal trolley tension of 11,000 volts, and in consequence one terminal of each machine is always grounded when in service. This point has been fully kept in mind in the design of these machines.

As the New Haven Railway Company contemplates operating certain existing direct-current systems from this power house, it was decided to add an additional leg to the armature winding, so that three-phase currents could be obtained for feeding into rotary converter stations for furnishing direct current for some lines which, at the present time, cannot be conveniently changed to straight alternating current. The New Haven Company also has other fields for three-phase power which it proposes to take care of as soon as it is feasible to do so.

The steam turbines for driving these generators are of the Westinghouse-Parsons type. The turbines are designed for the single-phase rating of the generators, as it is anticipated that the heavy service and the load peaks will be due to the railway load.

Electric Musical Instrument.

A patent was issued last week to M. L. Severy and George B. Sinclair for a musical instrument, in which sonorous bodies, such as steel or iron strings, are vibrated through the effect of electric pulsations. The piano strings have double electromagnets located to present poles oppositely at the proper striking point of the string. In circuit with the electromagnets are a make-and-break device and a key for closing the circuit, the latter being actuated by touch at the piano keyboard. The make-and-break cylinder, which has one section or disc corresponding to each key, revolves at a uniform speed. When a contact at the key is made, a current is made and broken by the revolving make-and-break cylinder at such a rate as to give a definite number of magnetic pulsations to the corresponding electromagnet, which pulsations are communicated to the piano wire. Heretofore a difficulty encountered in this class of invention has been that among the 12 notes of an octave there are several which vibrate at a rate which can only be expressed fractionally, and exact correspondence cannot be obtained by forming a disc with a certain number of whole teeth and a fraction of a tooth. The inventors state that they have discovered that by leaving a blank space in the disc at the point where a fraction of a tooth would otherwise occur when the remainder of the disc was cut in accurate correspondence with its string's vibrations, they can obtain the desired perfect correspondence through practically the entire

rotation of the disc and with no disagreeable alteration in the tone at any point. It is stated that the results accomplished by this simple expedient are wonderful, far beyond in volume and body of tone anything before accomplished in this line. The actuating electromagnet is double, and when one member is imparting a pull to the string the other member is dead. This is accomplished by having two brushes for each string, one of which is displaced circumferentially with respect to the other.

Starting Torque of Induction Motors.

By R. E. Hellmund.

MOST of the publications treating of the starting conditions of induction motors deal with the determination of the average starting torque; that is, the average of the torque values which the rotor gives in its various positions. This value, however, is of little practical importance, since experience shows that in a motor which may have a good average starting torque, the torque for certain rotor positions is so small that the motor does not start up from such positions even under no-load. It is, therefore, very important to predetermine the value of the smallest starting torque, which may be called the "commercial starting torque." The purpose of this article is to deal with this question.

The only quantity having effect upon the change in the torque which takes place with variations in the rotor positions is the magnetic leakage, due to the changes in the zig-zag and belt leakage, the reluctance of the main flux bath being practically constant in most cases. It can easily be shown that the starting torque can be expressed in synchronous watts as the copper loss in the secondary conductors. Since with a certain value of primary and secondary resistances the secondary current at starting decreases with an increase of magnetic leakage, it will be appreciated that the starting torque, which is proportional to the square of the secondary current, decreases very rapidly with increase of the leakage.

In order to show how much the starting torque of the same motor may change for different rotor positions, there is shown in Fig. 1 a curve giving the values which the torque may assume

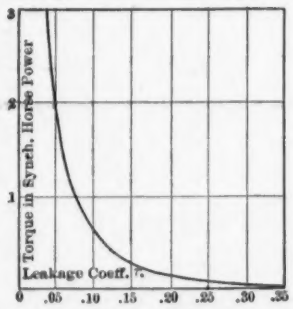


FIG. 1.—RELATION BETWEEN LEAKAGE COEFFICIENT AND STARTING TORQUE OF AN INDUCTION MOTOR.

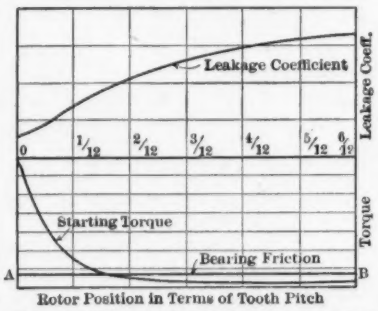


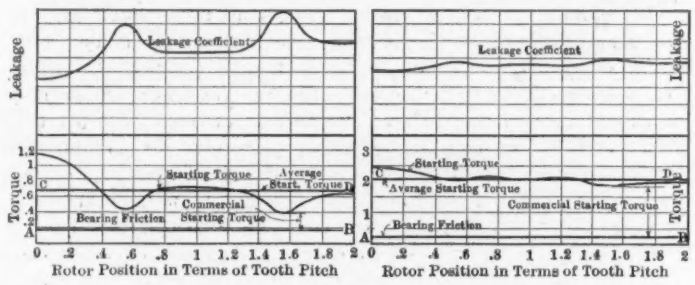
FIG. 2.—RELATION BETWEEN ROTOR POSITION, LEAKAGE COEFFICIENT AND STARTING TORQUE OF A THREE-PHASE INDUCTION MOTOR WITH ONE SLOT PER POLE PER PHASE IN THE ROTOR AND STATOR.

for different values of the leakage coefficient. The upper curve in Fig. 2 gives the values which the leakage coefficient may assume in a three-phase motor with one slot per pole per phase in the stator and in the rotor, while the rotor occupies positions extending over a distance of only one half of the tooth pitch.

From this curve and that of Fig. 1 is derived the lower curve of Fig. 2, which shows the torque exerted by the rotor as a function of the rotor position. The straight line, *A B*, shows the torque which is necessary to overcome the bearing friction of this motor. It is obvious that the motor will not start up even under no-load from all rotor positions for which the curve is below the line, *A B*, while for the other rotor positions the torque of the motor is proportional to the distance between the line, *A B*, and the curve. The commercial starting torque of this motor is zero, while the average starting torque is fairly good. This case is, of course, more unfavorable than any which occurs in practice.

The upper curve of Fig. 3 shows the leakage of a four-pole, three-phase motor with four slots in the stator and in the rotor as a function of the rotor position as derived under certain assumptions from a curve given by Prof. C. A. Adams in his paper on "Leakage Reactance of Induction Motors."*

The torque of this motor for various rotor positions is given by the lower curve in Fig. 3. The average torque is 3,730 synchronous watts corresponding to 5 synchronous horse-power,



FIGS. 3 AND 4.—LEAKAGE COEFFICIENT AND STARTING TORQUE OF THREE-PHASE MOTORS WITH FOUR SLOTS PER POLE PER PHASE.

while the commercial starting torque is only 1,790 synchronous watts corresponding to 2.4 synchronous horse-power; that is, 48 per cent of the average.

Similar curves are given in Fig. 4, for another four-pole, three-phase motor with four slots per pole per phase in the rotor and in the stator. The average starting torque is here 1,515 synchronous watts, corresponding to 1.9 synchronous horse-power, while the commercial starting torque is 1,230 synchronous watts, corresponding to 1.6 synchronous horse-power; that is 87 per cent of the average.

In this case the commercial starting torque will in reality be still better, since the motor has open slots in both members. Thereby the reluctance of the main leakage path is increased just for those rotor positions for which the leakage has its maximum; this causes an increased starting current and a better starting torque for these positions.

In this connection it may be shown that the choice of a small "largest common divisor" between stator and rotor slots is in reality not so important as usually assumed. If, for example, the motor, for which the torque is shown in Fig. 4, would be built with 16 poles while the other characteristic data stay the same, the commercial starting torque would be again 87 per cent of the average, in spite of the very large common divisor, $4 \times 3 \times 16 = 192$. In contradistinction to this result, the motor of Fig. 3 if built with 2 poles, has a common divisor of only 6, and the commercial starting torque is zero. It is very important, therefore, to know the value of the largest possible leakage coefficient of a motor, in order to predetermine its exact commercial starting torque.

A mathematical predetermination of the highest leakage coefficient from the dimensions of a motor is not always very simple. In most practical cases, however, certain standard motor types will be at the disposal of the designer, and it is a simple matter to find the largest value of the leakage coefficient by testing the motor for different rotor position.

After this it is possible to predetermine the commercial starting torque by simply using this largest possible leakage coefficient as basis for the calculation of the starting torque.

In a motor with squirrel-cage rotor it is necessary to take at the same time the eddy currents into account which are caused by the high frequency in the rotor end rings when the motor is being started. They have in some cases a considerable decreasing effect on the starting torque in so far as they increase the watt component of the starting current, thereby decreasing the secondary starting current and the synchronous watts.

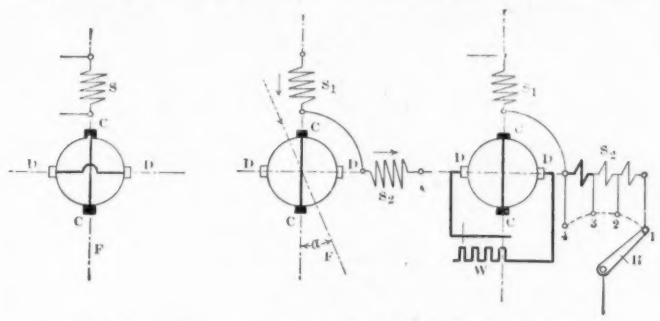
Only in motors with wide open slots in both members is it necessary to take into account the influence of the rotor position on the reluctance of the main flux path.

* Transactions of the International Electrical Congress, St. Louis, 1904. Vol. 1, page 706.

Self-Starting, Constant-Speed, Single-Phase Motor.

At a meeting of the British Institute of Electrical Engineers, held on March 8, a paper was read by Mr. V. A. Fynn describing a recently developed type of alternating-current commutator motor which possesses several features worthy of note. The machine starts with a good torque as a repulsion motor and operates with a high power factor as a modified single-phase induction motor. The characteristics of the motor may be understood most readily from a study of Figs. 1 and 2, which show diagrammatically the two forms of machines which are combined to produce the new motor.

In Fig. 1 the primary member is magnetized along an axis, *F*, by means of the winding, *S*. The secondary member, which consists of an armature provided with a continuous-current winding connected to a commutator, is short-circuited by means of the



FIGS. 1 2 AND 3.—DIAGRAMS OF COMPONENT MOTORS.

brushes, *C C* and *D D*, along two perpendicular axes, one of which coincides with the field axis of the primary member or stator. This motor has all of the characteristics of the single-phase squirrel-cage motor and is called a "shunt-induction" motor. It will not start from rest; if brought up to speed it will do useful work, running somewhat below synchronism, but its power factor is bad. It is very liable to spark at the commutator, and its output for a certain weight is small. The author obtains a starting torque by using the machine as a repulsion motor when at low speed, using the connections shown in Fig. 2. A stator winding, S_2, is added and the brush circuit, *D D*, is opened. The field in the axis of S_2 is due to the total current flowing through the stator windings, and it is practically in phase with it. This field is nearly in phase with the current in the rotor circuit, *C C*, due to transformer action from the winding, S_1. This machine possesses characteristics quite similar to those of the series motor. The author refers to it as a "series-induction" motor.

The connections shown in Fig. 2 are used for starting purposes, and the machine is gradually converted to the connections shown in Fig. 1 as the armature increases in speed. A simplified diagram of the circuits employed is shown in Fig. 3. The switch, *H*, allows the turns in the winding, S_2, to be decreased at will. As the speed increases the rotor circuit is gradually closed through the resistance, *W*, the motor acquiring by degrees the characteristics of the single-phase induction motor. The author described special means employed to improve the power factor and to increase the output of the motor.

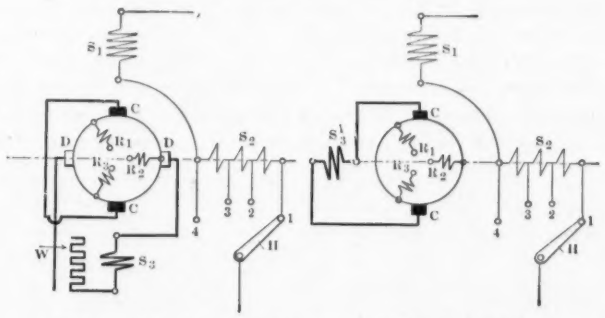
It has been shown that the motor in Fig. 1 is electrically the equivalent of a motor with a squirrel cage; it must, therefore, also behave like a motor having a rotor provided with a polyphase winding short-circuited by means of slip rings or otherwise; nothing in the nature of the motor would, therefore, be changed if, in addition to the two sets of brushes on the commutator, say, three equidistant points of the rotor, were short-circuited when up to speed. Use is made of a continuous-current and polyphase winding in the rotors, combined in such a way that, as far as the commutator is concerned, only the continuous-current winding is operative; while both continuous and polyphase windings are operative as far as the slip rings are concerned. The best possible use is thus made of the rotor winding space and copper. The commutator voltage depends on the continuous-current winding only. The polyphase winding is so disposed with regard to the continuous-current winding, as to obtain at the slip rings the highest possible voltage resulting from the combination of the two windings.

The method by which the phase of the motor field is varied in these motors consist in introducing into the circuit, *D D*, an auxiliary e.m.f. differing in phase from the e.m.f. produced in the rotor by cutting the primary field under speed conditions. The resultant of the two is then responsible for the motor field, and it has been found that an auxiliary e.m.f. differing materially in phase with the motor field gives the best results. Under these conditions the greatest phase displacement of the resultant e.m.f. can be obtained with the smallest auxiliary e.m.f., and without materially influencing the motor field strength.

The complete motor is shown diagrammatically in Figs. 4 and 5 in its two early forms, as arranged for "constant-speed work." For the sake of clearness, the slip rings have been omitted from the figures; they are connected to the points R_1, R_2, R_3 of the rotor winding.

The arrangement shown in Fig. 4 allows of the conversion of the motor from a series induction to a shunt induction machine by the gradual closing of the *D* circuit in combination with a gradual reduction of the number of turns in the group S_2, and, when desired, also in combination with a gradual decrease of the resistances inserted between the slip rings. A reduction of the resistances inserted in the *D* circuit and a reduction of the resistances between the slip rings increases the shunt excitation; a reduction of the number of turns in the group S_2 after the motor has started reduces the series excitation. At first both methods were used simultaneously on account of sparking difficulties, and one was naturally led to simplify this disposition by leaving out the *D* circuit altogether. The motor shown in Fig. 5 was thus evolved, and quite a number of such machines were built.

Although this last form of motor is simpler than that shown in Fig. 4, electrically it is somewhat inferior. The conversion from series induction to shunt induction working cannot be effected as smoothly with the help of the slip rings only (Fig. 5) as it can with the help of the *D* circuit (Fig. 4); and in the former case it is quite impossible in practice to avoid a very marked falling off in the starting torque curve, which makes this form of motor unsuitable when heavy and sustained starting



FIGS. 4 AND 5.—DIAGRAMS OF COMPLETED MOTORS.

torques are required. For light work, however, it is very useful, and its power factor under normal working conditions approaches unity. On the other hand, the starting torque curve of the motor in Fig. 4 (with or without the help of slip rings) is an almost straight line, and the motor in this form can be used in all those cases in which heavy and sustained starting torques are required, for instance: for elevator and similar work.

It is stated that a maximum torque, two and one-half times the normal, can be secured with about one and one-half times the normal current. The motors will start light with about no-load current, or not more than one-fourth of the normal full-load current. The power factor can always be brought up to unity; this, however, may entail a heavier current in the rotor and slightly higher losses. On that account the smaller motors are not, as a rule, fully compensated, as it does not appear advisable to lower the efficiency for the sake of improving the power factor by some 5 per cent. Thus, for small machines up to 6 or 7 hp, the power factor is only raised to 0.7 or 0.8 at no load, reaching 0.9 to 0.94 under load. The power factor curve rises very rapidly at first, and as the load increases it remains

nearly constant. The larger machines are designed for a power factor seldom falling below 0.9 and reaching 1; these can be made to take a leading current when desired.

The efficiency of these compensated motors closely approximates to that of good asynchronous machines with squirrel-cage rotors. In the smaller sizes it falls some 2 to 3 per cent below the latter, as is to be expected; since for small outputs only a small increase in the losses is sufficient to reduce the efficiency by several per cent. In this case the increased losses are mainly due to the friction of the brushes on the commutator and to the I^2R losses in commutator and brush gear. In the larger sizes the efficiency quite equals, and sometimes, for a large number of poles and high frequencies, materially exceeds that of the corresponding asynchronous motor. Altering an ordinary asynchronous single-phase motor to the construction which has just been described will increase its output from 30 to 40 per cent, besides vastly improving its power factor; but the increased output and the better power factor of these machines do not entirely compensate for the increased losses.

Parallel Operation of Synchronous Motor-Generators.

At the meeting last week of the American Institute of Electrical Engineers, Mr. J. B. Taylor read a paper dealing with some features affecting the parallel operation of synchronous motor-generator sets. In the early installation of these machines it was found that a set on being started and connected in parallel with others already carrying a load would, on some occasions, refuse to take any of the load, and at other times it would take a great deal more than its proper share of the load. As a result of these early troubles numerous station operators retain the impression that unless certain special combinations of field excitation are used at the instant of paralleling, the proper division of load will not result; and that once connected in parallel, further changes in field excitation will have no effect. The author showed, however, that the division of load depends upon the relative mechanical position of the poles of the generators when the motors are placed in parallel.

If the poles of the two generators are mechanically in the same relative position when the two motors are in parallel, then when the generators are connected in parallel there will be no interchange of current between the two generators. If, however, the poles of one generator are displaced from those of the other,

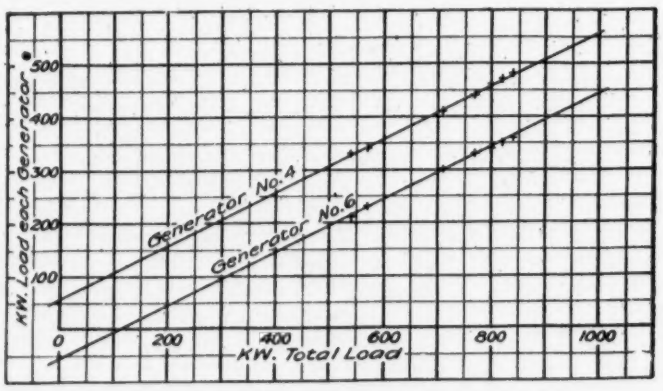


FIG. 1.—LOAD ON TWO 500-KW SETS.

then the current which flows locally through the generator circuits will tend to bring these two machines exactly into step; it will tend to accelerate one generator and to retard the other, so that one machine acts as a motor and the other as a generator with reference to this local current. The mechanical torque due to this action is transmitted through the shaft of each set to the corresponding driving machine, so that finally the machines assume a stable condition in which the machine which drives the generator which has become a motor for the local current, itself becomes to this extent a generator, while the other driving machine assumes a correspondingly greater load as a motor. It is seen, therefore, that the current which flows locally through the two generators is not "wattless," but it represents power, which is negative for one machine and positive for the other. Similarly, the local current in the motor circuits represents either positive or negative power according to the machine considered. The power in each case is approximately equal to that in the other and is the minimum that is possible for the mechanical displacement of the poles. That is to say, the mechanical displacement of the poles of the motors will increase, allowing that of the poles of the generators to decrease until the power circulating through the motor circuits increases to the decreased value of that in the generator circuits.

A change in the field strength of one of the generators will

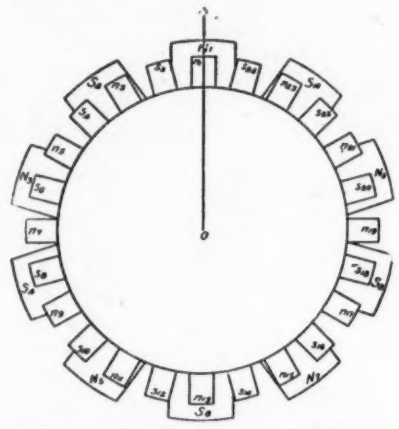


FIG. 2.—MECHANICAL ARRANGEMENT OF POLES ON A 25 TO 60-CYCLE SET.

not appreciably alter this circulation of power, but it will introduce a "wattless" current in the generator circuits.

Fig. 1 indicates the interchange of load between two 500-kw sets in which one machine took approximately 110-kw more than the other at all loads. This difference, a matter of about 20 per cent, was corrected by drawing off one of the revolving field cores and inserting a new key so as to give an offset of a few hundredths of an inch. At present there is a difference of only 10 kw in the loads taken by the two sets.

In discussing the placing in parallel of exactly similar motor-generators used in transforming from 25 to 50 cycles, or from 30 to 60 cycles, the author stated that it is apparent that, with the motors connected to the mains, the generators will necessarily have proper phase relations for connection in parallel, because every one of the north poles on one generator is directly in line with a similar pole on the other generator. With a set working between 25 and 60 cycles, however, the smallest number of poles possible is 10 for the motor and 24 for the generator. Fig. 2 represents such a set. A study of this figure will show that there are only two poles on the motor which will give proper phase relations on the generator end. Therefore, with one of these sets in service, to connect in parallel a second set, it is necessary to bring one or the other of these two poles to the reference point, the reference point being already determined by the set in service. This means that it is not sufficient to phase the set for one end only, but it must be phased for both motor and generator ends simultaneously. This may be done by one of several methods.

When the 25-cycle motors of the sets are in synchronism, the 60-cycle end of an incoming set has one chance in five of being correct for connecting in parallel with other sets already in service. The Chicago Edison Company uses a special synchronism indicator with two hands appearing on the same dial. The position of the 60-cycle hand on the indicator shows whether or not the phase relation is correct. If incorrect, the switch in the circuit to the synchronous motor is opened, and the set begins to slow down; the two hands of the synchronism indicator begin to revolve at different speeds, the 60-cycle hand making 2.4 revolutions for each revolution of the 25-cycle hand. The operator closes the switch at the instant when both hands appear at the top of the dial simultaneously, indicating proper phase

relation for the two machines. At a substation of the Fonda, Johnstown & Gloversville Railway Company phasing lamps and a voltmeter are connected between the incoming generators and the bus-bars to show whether or not the phase relation is correct for connecting in parallel. If this relation is correct the voltmeter reading is normal and the lamps burn at normal brilliancy. Anyone of the other four possible phase relations will, however, give a different reading on the voltmeter and only partial illumination of the phase lamps. A double-pole, double-throw reversing switch in the field circuit of the synchronous motor is employed to allow the motor to drop back one pole at a time until the generator stands in the proper phase relation to the bus-bars.

The paper contains a table giving date on synchronous motor-generator sets, showing the required speed and number of poles for converting from one frequency to another, and indicating the chance of the generator phase being correct when the set is started by the synchronous motor. It is interesting to note that while a 25-cycle to 60-cycle set will be correct one time in five, a similar set used to transform from 60 cycles to 25-cycles will be correct only once in 24 times.

The Relation of Load-Factor to the Evaluation of Hydroelectric Plants.*

BY S. B. STORER.

The value of any water-power plant is due primarily to its earnings dependent on the market for its output, and secondarily to the type and quality of the apparatus installed and of the development as a whole. In the case of plants that are in process of development, or that are only partly loaded, the value is, of course, more or less of a speculative nature, and is estimated on the basis of possible and probable income. Prospective earnings as well as actual earnings necessarily rely on selling an amount of power equal to the maximum or the ultimate capacity of the development; and the number of hours per day during which the maximum capacity can be utilized is a definite factor in deciding the price at which the power is sold. This is equivalent to saying that earnings depend on the load-factor, where that is considered as the ratio between the average output of the station and its rated capacity. Carried to the extreme, zero load factor means no market for the power and consequently no value to the plant. The type or class of installation, whether good, bad or indifferent, does not affect such valuation, for the reason that the plant represents nothing as to earning power.

Few large hydroelectric plants exist to-day the values of which are not to a considerable extent speculative or problematical, owing to their operating at an output somewhat below their rated or their ultimate capacity. In some cases it has been so difficult to find a market for power that plants have passed through reorganizations with a resultant heavy loss to investors, and still

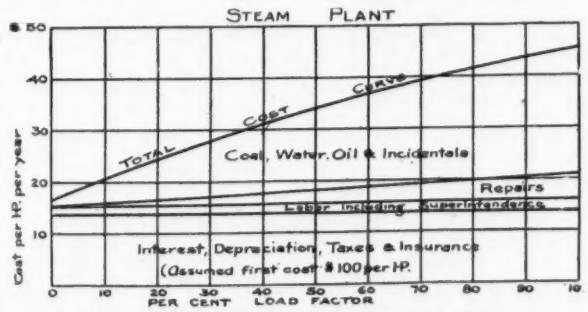


FIG. 1.—COST OF ENERGY FROM A STEAM PLANT.

are unable to show any profit or even to pay operating expenses, though power may be offered at rates so low as to be ridiculous when compared with the cost of generating it from coal or gas. No large water power development succeeds in marketing its output except through a reduction in its selling price to a point very much below that at which it could be produced from coal. Generally the load is obtained from a combination of low-priced power at the generating end with an additional load obtained by transmitting some distance to a market that will bring

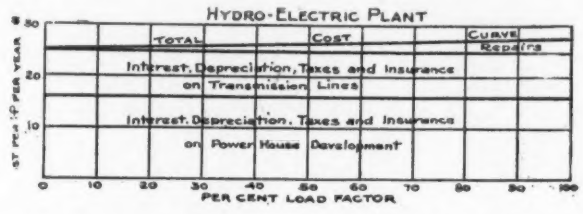


FIG. 2.—COST OF ENERGY FROM A HYDRAULIC PLANT.

a higher price. At other plants the entire output is carried a long distance before a suitable market can be found. In both instances the cost of transmission lines and attendant apparatus should be added to that of the power-house development, and included in the cost of the plant as a whole; this may raise the price of power to such a point as to render it non-competitive with power produced by steam or by gas.

This is particularly true of factories having low load-factors, due to operating only 8 or 10 hours a day. In such cases the necessary income can only be obtained through the sale of surplus power during the hours when the load is below the rated output of the power house. Similar conditions are well known, as they have been faced by every large water-power company. It will generally be found that the most successful plants are the ones that have the highest load-factor. The ideal load is one that remains constant throughout the 24 hours, the plant consequently putting out every kilowatt-hour within its capacity. Any water-power plant loaded in this way can sell power at a price very much below its cost when produced by steam, and still leave a good margin of profit on the investment.

It is generally conceded that the only object in developing a water power is to generate electrical energy at a cost much below that of generating it in any other way, and users of power are so well educated to this fact that they will not buy hydroelectric power unless the saving effected is considerable. It must be much more in fact than that for which they would, for any other purpose, make an expenditure several times as great as that necessary to replace other prime movers.

Comparing the cost of generating hydroelectric power with that from coal or gas is somewhat difficult, but the general method to be followed is shown graphically in the curves given herewith. Figs. 1 and 2, are made respectively for both steam plants and hydroelectric plants, and show the cost of production per horse power per year with relation to load-factor. In neither of these cases is the value given from an actual installation, but is merely an approximation indicating the general conditions as they might exist in any well-built power house of a rated capacity of from 5,000 to 50,000 horse-power. The principal dif-

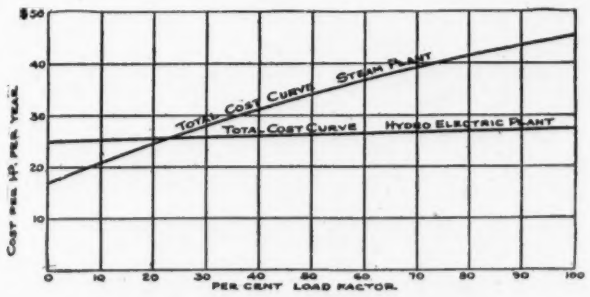


FIG. 3.—SUPERPOSITION OF COST CURVES.

ference between the two curves is due to the introduction of the variable items of coal, water and labor in the steam plant, while the fixed charges in both cases form the base of the area included under the curve. As usual, the fixed charges include interest, depreciation, taxes and insurance. With hydroelectric plants the operating expense is so nearly constant as also to become practically a fixed charge. The item of repairs is really

* A paper presented at the 205th meeting of the American Institute of Electrical Engineers, New York, March 23d, 1906.

the only variable in the curve, this generally being considered as increasing in direct proportion to the load-factor.

By superposing the two curves, as shown in Fig. 3, it will be seen that in this assumed instance they cross each other at 25 per cent load-factor, the cost per horse-power per year being identical at this point. At load-factors less than 25 per cent, the steam plant has the advantage, and hydroelectric power must be sold at a loss in order to be competitive. At all load-factors above 25 per cent, however, the advantage lies with the hydroelectric plant. The relative value of the two may be obtained by considering the variables—coal, water and labor—of the steam plant as the equivalent at any given load-factor, of a fixed charge, and by capitalizing this at a rate that will include interest, taxes, and depreciation, and adding it to the first cost of the steam plant we can thereby obtain an approximate value of the hydroelectric development.

Making the comparison in another way, the water operating the hydroelectric plant can be made a variable following the line taken by the coal of the steam plant, and by capitalizing the difference between the two curves an approximate value of the potential energy of the water can be obtained. Due consideration must be given to the fact that at load-factors of less than 25 per cent this capitalization is negative and must be taken from the actual cost of the plant, so that it is only at load-factors above 25 per cent that it has any real value. In addition the curve representing power cost from the steam plant must be discounted by an amount corresponding to whatever reduction must be made in hydroelectric rates to effect its sale.

The conclusion is that in all places where the flow of water is constant throughout the year the load-factor determines the earning power and hence establishes the value of any plant. Where an intermittent or insufficient supply of water may be stored and used during times of peak loads at a rate much higher than the normal flow of the stream the earning power is not dependent on the load-factor to so great an extent, but such hydroelectric plants are generally of small capacity, adapted for lighting purposes only, and are to be considered as an exception to which the above method of evaluation will not apply.

Design of Hydroelectric Power Stations.

A paper dealing with the design of hydroelectric power stations and having particular reference to the influence of the load-factor was read by Mr. D. B. Rushmore before the recent meeting of the American Institute of Electrical Engineers.

The author stated that hydroelectric installations naturally divide into somewhat clearly defined classes, depending upon conditions. The western high-head plant, with great fluctuations in stream-flow and with long ditches and pipe-lines, containing but few units and feeding into a high-tension network, is under different conditions from a low-head, many-unit, single-plant installation delivering power over short distances or to a single point. Reliability of service is not of such great importance in irrigation pumping as it is in the lighting supply of a large town. This is not always recognized in the discussion of comparative advantages of small complications necessary to obtain reliability of service as compared with extreme simplicity and home-made switching apparatus. Conditions which have proved satisfactory in the West could not be considered for systems which are never allowed to be out of service.

The number of plants to the system and the distribution of plants on different watersheds materially affect conditions of design and operation. A single plant with all the power transmitted to one place represents the most severe conditions; many plants, widely separated, on different watersheds, with steam auxiliaries and widely distributed use of power, the most favorable so far as load conditions are concerned. The class of service has an important bearing on the system of control. Where conditions of contract do not severely penalize trouble, much simpler arrangements can be used than where it is demanded that no expense be spared to insure against interruptions.

Upon the exact definition of load-factor there is a lack of agreement. In the paper it is designated as the ratio of the average output to the maximum output. For considerations of storage, the load-factor of stream-flow has a vital bearing on the amount and cost of development. The great problem of hydraulic development is to transform the stream flow to correspond to the load curve. The design of different elements is determined by various limits, some of which are but indirectly connected with the load-factor. Water conductors should primarily be of sufficient capacity for the worst conditions—not always the case. The grade of ditches may vary from 40 ft. per mile for small ones, to 10 ft. or less per mile for large, the allowable velocity depending on the soil. Velocities should be sufficient to prevent the growth of vegetation in ditches, but not sufficient to cause erosion.

Velocities in flumes may range from 8 to 20 ft. per second. Tunnels, when lined with concrete, may have a friction-coefficient of from 0.010 to 0.012. The complete cost may vary from $5 to $6 per cubic yard, or from $20 to $30 per lineal foot, for a 9-ft. tunnel. The coefficient of friction with rough rock walls will be from 0.030 to 0.035. For lined tunnels, 12.5 ft. per second is given as a conservative velocity. Velocities much higher are in use in short lengths.

Velocities in pipe lines vary from 3 to 15 ft. per second. Wooden pipes with low velocities are often used at the upper ends, but the greatest loss of head should occur at the bottom in the most expensive pipe. The thickness and factor of safety used increase with the head. For all high pressure work, riveted sheet-steel pipe is now universally used.

The best type of wheel to be used depends upon the head, quantity of water, speed, and range of load. Turbine wheels are efficient through only a small range of load, and under high heads are not easily regulated. In general, with low heads, large quantities of water and a number of generators to the plant, turbines are used. For small quantities of water, high heads, variable-head impulse-wheels are employed.

For large developments, the selection of reservoir sites and capacities requires special investigation. Often several main reservoirs check the river flow, and a regulating reservoir at the head of the pipe line gives constant ditch-flow and carries the load temporarily in case of accident to the water supply. If great fluctuations in stream-flow obtain, it is seldom possible, from a commercial standpoint, to store all the water. Where development exceeds minimum stream-flow, there are only a few high-head propositions where storage is not desirable; conversely, in many low-head installations the cost of storage is prohibitive.

Wheels and generators demand careful study to decide the best capacities. The size of the generator is usually indicated by some conditions in the proposition. The loss of one unit should not cripple the service. The generators and wheels should operate at points of best efficiency. The generator and wheel combinations are limited, and speeds are fixed by number of wheels, type, head and output. For one-plant systems the number of generators is preferably not less than four nor more than eight. For multiple-plant systems, one unit to the station is not uncommon.

The cost and value of efficiency in power plant designing is an important but not clearly understood subject. The rough approximation usually made is to compare the selling price of the increased output with the interest charge on the greater cost. Where the saving in energy can be sold, as is usually the case, a higher efficiency in water conductors means a greater output, and a greater capacity of installed apparatus with higher total cost, so that the investment charge for the gain in power is greater than usually considered. This is true of all parts of the chain of energy transformation. Water wheels can be made of the best efficiency by designing them for the special conditions, instead of using standard patterns, and by the employment of a high grade of material with careful finish. The life can be increased by use of expensive metals and by cleaning the water. Wheels probably differ in efficiency much more than electrical apparatus. Doubt simply implies difficulty in hydraulic testing and scarcity of reliable results.

With a limited water supply, storage of water determines

the possible development. Variations in load occur by the hour, day, season and year. Auxiliary or regulating reservoirs at the head of the pipe-line take care of daily peaks, keep an even load on the water conductors, and serve to carry the plant over temporary ditch troubles, also serving as sand boxes. The location of the pipe-line often renders storage at this point impossible. In one case, a flume of large dimensions is used for peak storage. In another, the water supply to a flume several miles in length is cut off entirely and the total stream-flow used for another station.

Main reservoirs are on the river and regulate its flow. If these are of sufficient size, the total run-off can be used. The Reclamation Service is at present doing a great work in water storage, in some cases over a term of years. Snow is a natural form of storage, well illustrated at Puyallup, where with a great variation in rainfall a nearly constant stream-flow is obtained. Forests, vegetation, and the soil fill the function of reservoirs. Dams are built to catch the underground waters.

For suddenly varying loads, as in railway and hoisting work, a fly-wheel is used to provide for instantaneous peaks. Irrigation laws may forbid the storage of water on old ditches. Electrical storage, at the distributing points, bears to the electrical system the same relation that the regulating reservoir does to the hydraulic.

The capacity of a water-power installation can usually be largely increased by the use of steam auxiliary plants. A steam plant can supply the deficiencies of stream-flow, and can carry peaks in any season. It may act as a regulator with steam turbine floating on the lines, the hydraulic generators running under constant load; it may act as a reserve in case of breakdown on line; and may serve to furnish the wattless current for the system, allowing other machines to carry greater overloads. The turbine unit may be run idle part of the year as a synchronous condenser, or may float on the line as such for part of the day and deliver energy at other times. Contracts for supply of continuous power, with severe penalty clauses, may necessitate the installation of an auxiliary plant at the distributing end of the line. Such a plant is now being installed at San Francisco.

Recent Electrochemical Developments.

COPPER AND NICKEL.

We have repeatedly referred in these columns to the important problem of separating copper and nickel. On a large commercial scale this separation is at present carried out by the Orford process which is purely metallurgical. The molten matte is subjected to contact with sodium sulphide whereby gravity separates the lighter copper and iron sulphides from the heavier nickel sulphide. Naturally the separation cannot be very sharp and the resulting metals are impure. For this reason the endeavor of a series of experimenters has been in years past to devise an electrochemical process and we have to record here two new attempts in this direction, both being due to former engineers of the Orford Copper Company.

N. V. Hybinette patents for this purpose a double-fluid cell with the cathode department in the center, enclosed in a specially prepared diaphragm chamber, while the anode departments are placed outside. The anodes are made of the alloy of copper and nickel which is to be separated. Pure nickel sulphate containing a small proportion of a weak acid is supplied to the cathode department so that nickel is continually deposited upon the cathodes. The electrolyte is kept on a higher level in the cathode department than in the anode department, so as to produce a continuous stream of nickel sulphate solution through the diaphragm outside towards the anodes. From the anodes copper and nickel are simultaneously going into solution, but this mixed electrolyte cannot pass over to the cathode department on account of the opposite stream of electrolyte just mentioned. In the anode compartment an overflow is so provided that the mixed solution of copper and nickel sulphates continually flows off. From this mixed solution the copper is removed by cementation upon nickel or a nickel-copper alloy. The solution which thereby becomes pure nickel sulphate is then supplied again to the cathode department of the electrolytic cell. The nickel sulphate electrolyte, therefore, passes through a cycle. The copper is removed by cementation and the nickel by electrolytic deposition.

Woolsey McA. Johnson proposes to carry out the separation on the following principle: The copper nickel matte is subjected to the action of hot sulphuric acid whereby nickel is dissolved and hydrogen sulphide liberated while the residue consisting in part of copper sulphide is left. This residue is roasted to oxide and leached with sulphuric acid so as to form a solution which contains copper sulphate with a small amount of nickel sulphate. This solution is electrolyzed with insoluble anodes of lead, the gases from the roasting operation being passed through the bath. These gases serve the double purpose of reducing the e.m.f. necessary for electrolysis, for they act as a depolarizer, and of yielding sulphuric acid in such quantity as to be sufficient for subsequent solution of both the nickel and the copper of the residue. Electrolysis is continued until the presence of nickel would interfere with the deposition of copper. The solution is then transferred to other cells and further quantities of copper are deposited upon rotating cathodes. The electrolyte is then used for leaching new quantities of matte.

ZINC.

Of our modern metallurgical arts the production of zinc has undergone the least changes during the last 100 years. It is, therefore, not surprising that strong endeavors to apply electrochemical methods to the problems of this industry are at present made. De Laval in Sweden is known to use an electric furnace for the production of very pure zinc. While he uses an arc furnace, W. McA. Johnson in a recent patent proposes to use a resistance furnace. The patent refers mainly to the difficulty of smelting ores of zinc containing iron or other substances which are liable to flux or otherwise injure the walls of the retort. The remedy proposed in the patent is to interpose between the charge containing low-grade ore and the furnace wall a high-resistance charge containing high-grade ore and a layer of inert material, whereby the wall is protected against the action of the low-grade ore.

F. T. Snyder proposes a process which is partly electrothermic and partly electrolytic. The principle is to mix zinc sulphide ore with carbon and with a slag-forming material and to smelt the mixture upon a bath of molten slag in an electric furnace from which air is excluded, whereby the zinc sulphide breaks down while simultaneously carbon bisulphide is formed. The zinc vapor and the carbon bisulphide vapor are separately condensed.

VARIOUS ELECTRIC FURNACE PROCESSES.

In connection with the trial of the Héroult furnace at Sault Ste. Marie for the production of pig iron from ore two recent patents of this inventor is of great interest. The inherent commercial difficulty of using the electric furnace for pig iron production lies in the cost of electrical energy, and in order to reduce this energy it is necessary to utilize to the utmost the calories available in the fuel required for reduction. This means that the carbon should be oxidized to carbon dioxide and not to monoxide. For this purpose Héroult feeds the ore from the top and introduces the fuel at the base of the charge while protecting it from the action of the carbon dioxide generated by the smelting operation. A mixture of carbon monoxide and carbon dioxide is, thereby, formed with gradually increasing richness in carbon dioxide as the gases rise to the point at which the reduction of ore practically ceases. At this point oxygen is blown into the furnace to oxidize the remaining carbon monoxide and to increase the heating effect. One of Héroult's patents refers to his process, the other to the apparatus.

M. Ruthenburg patents an arrangement of the electrodes for a steel furnace which is quite different from his former well-known furnace construction and is more similar to Héroult's steel furnace. Upon the molten steel a layer of inert material, for instance fused slag of bauxite, is placed, while upon this slag flows a comminuted mass of coke or carbon. The carbon electrodes dip into this mass of coke. The heat is transferred to the steel bath through the layer of slag.

Henry Noel Potter, who has already done a great deal for

the development of the electric tube furnace, patents two carefully designed constructions for two special purposes. One is intended for use when gases or vapors are to be passed into the furnace under pressure and are to be subjected to intense heat during the passage. The other type serves the opposite purpose, namely, when the heating process is to be carried out under reduced pressure, so that this type may be called a vacuum tube furnace.

Letter to the Editors.

The Inverted Gas Burner.

To the Editors of Electrical World:

Sirs:—Referring to the editorial in your issue of March 17 commenting on my paper on the inverted gas burner read before the recent monthly meeting of the Illuminating Engineering Society, I would thank you to publish the concluding paragraph of the paper, which reads as follows:

"In conclusion, I may say with our English brethren, that the problem is not yet solved, but with so many capable engineers all over the world at work on the subject, a good, reliable, and simple lamp must be evolved, and then gas consumers will be provided with a burner that will give at least 60 candle power on a consumption of not more than three feet of gas, and when the fixture designer gets in his good work by constructing fittings to suit the burner, an enormous field will be opened up and the public will welcome the advent of an appliance that will give the decorative effect of an electrolier, but with more light and at a greatly reduced cost. Gas men must join me in hoping that this day is not far distant."

The purpose of my paper was to show to all interested parties the existing defects, and in some cases, to suggest slight improvements. If such a paper will hasten the perfection of the inverted lamp, I shall feel my effort was not in vain.

New York. Victor A. Rettich.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Design of Direct-Current Generators.—Breslauer.—The first part of a study in the design of a 500-kw, direct-current generator with some general remarks on dynamo design. According to the writer's experience there are very few generators at present in use in central stations which allow overloads up to 20 per cent, or even full load, to be suddenly switched off and on without moving the brushes and without showing any signs of sparking, although this is generally required of and can be fulfilled by the most recent machines and was a condition specified in the present case. The author gives the following formula for the reactance voltage: $e_r = 0.133 m_s l' i_m n \times 10^{-8}$, where m_s represents the number of conductors per segment, l' the magnetic conductivity, i_m the ampere-turns of the armature and n is speed. Experience shows that the reactance e.m.f., e_r, thus calculated, must not, under ordinary conditions, exceed 2 volts if no brush movement is permitted from no load to 20 per cent overload. This, of course, is not the only condition, since the ratio of armature ampere-turns to the ampere-turns required for the gap, teeth and core is of no less influence, but must be treated separately. It must be understood that with a reactance e.m.f. of 2 volts, the brushes cannot be kept in the geometrically neutral point, but already require a fixed constant lead. For brushes in the neutral positions, as, for example, with reversible motors, a reactance e.m.f. greater than 1.1 volt is not admissible, but in cases where shifting of the brushes according to the load is allowed, the limit for e_r can be extended up to 3.2 volts. The author then compares his method with that of others for calculating the reactance e.m.f. and then applies his method to the special 500-kw generator under discussion. This machine has 10 poles, the normal current is 910 amp., there are 144 slots with 8 conductors per slot, and 575 segments. Hence, the total number of conductors is $8 \times 144 = 1{,}150$, and as the armature is lap-wound with 10 parallel circuits, the effective number of conductors would be $m = 115$. The total armature iron length (1) with insulation but without ventilating ducts is 27.5 cm., and the mean length of one conductor is 95 cm., leaving a free length of 67.5 cm.; therefore, $1' = 1 + 0.1\,lf = 27.5 + 6.8 = 34.3$ cm. Further, as there are 1,150 conductors and 575 segments, the number of conductors per segment (m_s) is 2. The speed being 300 r.p.m., the formula for the reactance e.m.f. yields $e_r = 2.9$ volts. The reactance voltage is, therefore, very high. If we consider further that the output coefficient which is the ratio of the product d^2l to watts per revolution, $G = \frac{1d^2}{watts\ per\ rev.} = 32.4$, is rather small, and that the number of ampere conductors periphery is not higher than 240 per cm., or 960 per inch diameter, nothing abnormal can be found in these two values to explain the good results obtained with this machine. We know, however, that next to reactance voltage the ratio of armature ampere-turns per pair of poles AT_2, to the ampere-turns for air-gap, teeth and core is of prime importance. This ratio in the present machine is 0.88 and at 20 per cent overload 1.05. In general if this ratio is above 0.7, a machine is not considered safe, and 1.0 is assumed to be the very limit. Hence, in this respect also the machine seems to be dangerous and to considerably exceed the orthodox limit of design. The article is to be continued.—Lond. *Elec.*, March 9.

Single-Phase Commutator Motor.—Czepek.—The author has made a series of tests of a four-pole motor which as a single-phase series motor was designed for a capacity of 7 hp at 110 volts, 50 periods and 1,500 r.p.m. The motor was tested as a direct-current series motor, as a single-phase series motor, as a repulsion motor, as a Winter-Eichberg motor with field and armature coils directly in series, as a single-phase induction motor and as a polyphase motor, the results being given in comparative tables. The influence of the brush position on the starting operation, the effect of a change of frequency, etc., are discussed. It is mentioned that a series motor should be designed for as low a frequency as possible while with the repulsion motor it would be wrong to go below a certain limit, since the frequency should not be too small in order to get high torque and high efficiency.—*Elek. und Masch.*, March 11.

Use of Mica.—Abbott.—In some notes on practical experience of a district office engineer it is mentioned that a rotating field alternator hummed badly and investigation showed that the finger plates on the stationary armature were not stiff enough to hold the outer laminations firm between the coil slots. Several efforts were made to stop the trouble by upsetting the iron and finger plates, without entirely stopping the trouble. Finally thin strips of mica were driven between the iron laminæ, after having been coated with shellac. This method was successful.—*Elec. Jour.*, March.

Voltage Regulation of Alternators.—Letros.—The conclusion of his paper on the calculation of rheostats for regulating the tension of alternators.—*L'Eclairage Elec.*, February 17.

Lamps and Lighting.

Metallic Filament Lamp.—Some further information concerning the Kuzel metallic filament lamp which was noticed in Electrical World February 17, page 354, and in the Digest March 23, page 487. The present information is given on the authority of the English agents. The metals are reduced to a colloidal

state wherein their properties are somewhat modified by their very finely divided condition and Kuzel forms his filaments by forcing his colloidal preparation through a die. This, it is said, produces a much more durable filament than the ordinary wire-drawing method. Kuzel finds that by employing a mixture of different colloidal substances he obtains alloys with properties more suitable for filament construction than the components used separately, however high their fusing points. The lamps are exactly similar in appearance to the carbon filament type and the size of the bulbs identical. Two horseshoe filaments in series are used and the lamps can be made up to 110 volts. It is hoped, however, to extend the limit up to 220 volts. The actual mounting of the filament and exhausting of the bulb is precisely the same as for the carbon lamp, so that beyond establishing a new filament department no alterations are necessary in the equipment of an existing lamp factory. The efficiency claimed for the filaments for low-voltage lamps is indicated in the tests which were published, and it should be explained that the candle-powers given are mean horizontal, the Hefner unit being used. It has been found from a number of tests that a useful life of about 3,500 hours may be expected with a loss of candle-power varying from 2 per cent to about 11 per cent for lamps with a consumption in the neighborhood of 1 watt per candle, and that they will last as long as 5,000 hours with a diminution in light of 20 per cent. Lamps working at a consumption of about 0.75 watt per candle have been run for 1,000 to 1,100 hours with a loss of 3.5 per cent, and for 1,600 hours with a loss of 20 per cent. The lamps remain remarkably cool in use, as a very small portion of the radiation consists of infra-red rays. The lamps are equally suitable for alternating and continuous-current circuits, and can be overrun as much as 300 per cent without damage. The inventor looks forward to producing lamps with a consumption as low as 0.5 watt per candle.—Lond. *Elec.*, March 9.

Filament of a Mixture of Metallic and Electrolytic Conductors.—A filament made of an intimate mixture of a metallic conductor and an electrolytic conductor has the advantage over the purely electrolytic filament of the Nernst lamp that the former is a good conductor at ordinary temperatures and therefore needs no preheating. But on account of their non-homogeneous composition filaments of this kind are subject to considerable changes and the metal in the filament has a tendency to evaporate and to form a dark deposit on the lamp globe. Siemens & Halske propose to use tantalum as metal on account of its high melting point. Filaments made of a mixture of tantalum and a Nernst oxide are stated to be very durable and can be used in a vacuum while filaments of pure electrolytic conductors must be lighted in air wherefrom considerable losses of power result. With tantalum it is possible to make filaments of very high specific resistance. At the same time the temperature coefficient is favorable, since above a certain temperature the resistance becomes almost constant. Two methods are described for making such filaments. The first is to mix powdered metallic tantalum intimately with powdered zirconium oxide with a binding material like paraffin, and to bring this mixture into the proper form and sinter it together by heating with the electric current. The second method is to mix zirconium oxide with a conducting oxide of tantalum, which has the property of giving off its oxygen when an electric current is passed through it. A binding material like paraffin may again be used or not. By passing an electric current through it in a vacuum, the filament is heated to white heat whereby the oxygen of the tantalum oxide is completely given off if the oxygen gas set free is quickly removed by means of a pump.—*Zeit. f. Beleucht.*, March 10.

Incandescent Lamps with Reflectors.—SCHAEFER.—An illustrated article on the suitability of reflectors in connection with incandescent lamps. The author first shows that a reflector of half circular cross-section produces in general a rather non-uniform distribution of light while with a reflector of parabolic cross-section all rays are reflected in parallel lines, i. e., in one single direction, if the incandescent point is placed in the focus of the parabola. The trouble in using this property in connection with incandescent lamps is due to the fact that the filament cannot be considered as an incandescent point. Wulff has, therefore, devised an incandescent lamp in which the filament is a long, straight line while the reflector is made by bending a sheet so that its cross-section perpendicular to the direction of bending is a parabola. Each point of the filament is situated in the focus of a parabola. The lamp is of tube form, the filament being in its center in the form of a straight line and being held in tension by means of a spring.—*Elek. und Polyt. Rund.*, March 1.

Arc Lamp.—SIMON.—A study of the dynamics of arc lamp phenomena and arc lamp hysteresis. The method of characteristic curves is made use of.—*Zeit. f. Beleucht*, March 10.

Power.

Voltage and Cost of Transmission Lines.—ADAMS.—The author emphasizes that distance rather than voltage is the prime factor in the cost of long transmission lines. The total cost may be divided into those for conductors and those for poles, pins and insulators. Within rather narrow limits the cost of conductors may be held constant by varying the voltage directly with the length. Over much wider limits the costs of supports for the conductors varies nearly as the length independent of the voltage employed. On very long lines the cost of supports alone becomes one of the main items. If the voltage of a transmission is increased with the length, so that the weight of conductors may remain constant for the same percentage of loss, then the cross-section of each conductor must be made smaller and the consequent reduction of mechanical strength in the conductor puts a limit to the practicable voltage for many lines.—*Cassier's Mag.*, March.

Steam Turbine.—An illustrated description of the Zoelly steam turbine. While these machines are comparatively new, there is believed to be about 72,000 hp of them at work or under construction, mostly on the European continent, in plants installed by the Siemens-Schuckert Company.—Lond. *Elec. Times*, March 8.

Superheated Steam.—BIBBINS.—A long discussion of the results which may be obtained with superheated steam. Numerous diagrams and tables are given.—*Elec. Jour.*, March.

Drilling Machine.—An illustrated description of an electrically-driven portable drilling and tapping machine of German make.—*Am. Machinist*, March.

Electricity in the Foundry.—KNOWLTON.—A fully illustrated article on the use of electric power for foundry purposes, dealing especially with electric cranes, electric traction, the driving of various foundry machinery like sand sifters by electric motors, electric welding, etc.—*Cassier's Mag.*, March.

Traction.

Marseilles.—DUBS.—A long description of the tramway system of Marseilles. The total length of single track is 200 km. The power plant contains five generating sets of 1,000 kw, 5,500-volt alternating currents being transmitted to converter sub-stations.—*L'Industrie Elec.*, March 10.

Sub-Station.—A description of the Kingston sub-station of the London United Tramways Company. Three-phase currents are supplied to the sub-station at 11,000 volts with a frequency of 33⅓ cycles. There are seven separate 200-kw, single-phase transformers and two 500-kw rotary converters.—Lond. *Elec.*, March 9.

Electric Railway Engineering.—COOPER.—The third paper of this illustrated serial deals with the control of cars and rails operated by direct current.—*Elec. Jour.*, March.

Installations, Systems and Appliances.

Speed Regulation for Operation of Alternators in Parallel.—NEEL.—An illustrated description of the Bouvier speed regulator as used at the central station of Trouville for operating steam-driven alternators in parallel. In 1901 the International Society of Electricians in Paris proposed the study of practical means for using a single regulator for regulating the speed of any number of steam engines which drive alternators in parallel. The Bouvier regulator is claimed to fulfill this requirement in a perfectly satisfactory manner. The construction is shown in Fig. 1. The constant-load pump, *P*, drives a liquid which escapes through an aperture the section of which can be varied by a valve, *S*, the position of which is regulated by a centrifugal pendulum. For any speed of the pendulum the valve, *S*, has a certain position so that the pressure of the liquid has also a certain value. This pressure acts on a piston, *R*, and the pressure is counterbalanced by the pressure of the spring, *Z*. For any speed of the centrifugal pendulum the piston, *R*, therefore, has

a certain position. The piston, *R*, is connected in a rigid manner with the lever of the admission valve of the prime-mover. Any change of speed will bring the piston, *R*, from its old position of equilibrium to a new one and the principal point is that there are no oscillations whatever in reaching the new equilibrium.

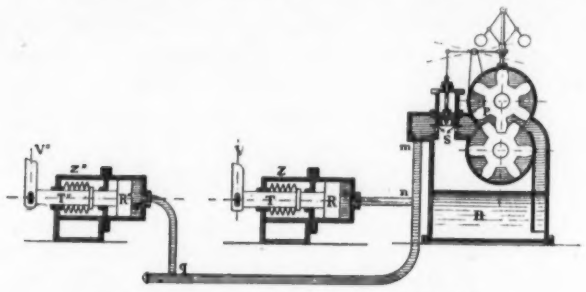


FIG. 1.—DIAGRAM OF BOUVIER REGULATOR.

The illustration shows the regulator connected to two prime-movers. The pump and the centrifugal pendulum are driven in synchronism with the prime-movers by electrical means which are described.—*L'Eclairage Elec.*, January 18.

Circuit-Breakers and Fuses in Series.—Marchant and Lawson.—It has long been known that when a fuse, designed to break circuit with a given current, is placed in series with a magnetic circuit-breaker, set for the same or even for some larger current, it is possible to put the circuit-breaker in action without blowing the fuse. The author has made a series of experiments with a circuit-breaker in series with different fuses. He first used the circuit-breaker in series with a number of equal fuse wires in parallel, and then tested the circuit-breaker in series with tin-fused wire of various diameters. These experiments were next extended to get the necessary data for obtaining a curve showing the relationship between the current through the magnetic circuit-breaker and the fusing current of wire in series with it, that will just not fuse for a given setting of the magnetic cut-out; a case which is, of course, one of great practical interest. The results of these tests are given in Fig. 2 and this curve is called the characteristic fusing current curve of the circuit-breaker. The whole area of it may be divided into two parts, one part shaded

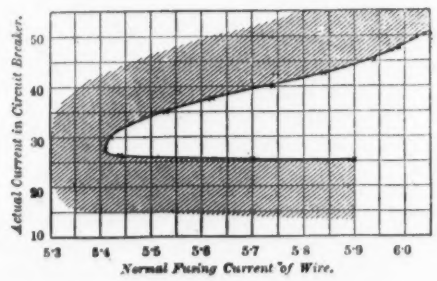


FIG. 2.—FUSE-CURRENT CURVE.

in the figure, such that if the point corresponding to a given current through the circuit-breaker, and a given fuse in series with the circuit-breaker, lie in it, the wire will be fused, provided of course that the current flowing exceeds the steady fusing current of the wire. If the point lies within the second part (left clear in the figure) the current corresponding to it will operate the circuit-breaker without blowing the fuse. It is interesting to note that any fuse wire smaller than that which blows at 5.4 amp. for this particular setting (25 amp.) will always be fused whatever the current flowing, provided, of course, it exceeds 5.4 amp. The authors finally describe some tests of the effect of various kinds of metal for the fuse. Their results point to the desirability of using fuses with high melting points, if the operation of circuit-breakers due to local short-circuits (say in a lighting system) is to be avoided. It is possible that the use of such fuses might obviate the necessity for the "time-limit" circuit-breaker in many cases.—Lond. *Elec.*, March 2.

Storage Battery for Supplying a Lighting Network from a Tramway System.—Jacobi.—In many cases the erection of a separate central station would not pay in small towns and it is often preferable to take the current from an interurban trolley system which passes the town. In such a case a battery is installed which supplies the lighting current, and it may be charged by and worked in conjunction with a motor-generator. The author gives some calculations to show that in such a system the efficiency is in the average not more than 56 per cent. He describes an arrangement by which a higher efficiency is obtained. It is shown in Fig. 3. There are two batteries, each being divided into two halves and each half consisting of 120 storage cells. Current is supplied to the lamps by means of a three-wire system at 2 × 220 volts. One booster is used for both batteries. A three-pole switch, *U*, for each battery connects it either to the three-wire lighting network or to the two-wire trolley network. The earthed neutral wire of the lighting network is disconnected when the battery is charged. The charging resistance, *W*, is mostly short-circuited and is used only at the beginning of a charge for a short time. The operation is as follows: Both batteries are to be charged daily. Since on short winter days only seven hours are available for charging, the charge must be made with full current. It is not necessary to overcharge the cells every day to 2.7 volts, it is in general sufficient to go to 2.5 volts. For this purpose 3¼ hours are sufficient. In a certain moment the battery, *I*, may supply current to the lighting network whereby the switch, U_1, has the position shown in the illustration. When it is intended to begin the charge of battery *II* the end cell switches are connected to the last notch; switch U_2 is brought into the position shown in the illustration and the battery is thereby connected to the charging circuit while the neutral wire is disconnected. Finally U_3 is turned to the left, and by means of the charging resistance, *W*, the charging current is maintained constant, while the voltage of the cells rapidly increases. In not more than 10 minutes the e.m.f. per cell increases to 2.1 volts, so that the charge of 240 cells requires 500 volts and the resistance, *W*, is then short-circuited. The e.m.f. then increases slowly to about 2.25 volts per cell. Simultaneously the last end cells are disconnected since they are now fully charged. There are on each end four cells. The next four cells are charged for about 2¼ hours. After this time only the main cells of the battery—224 in number—are in circuit and receive now about 2.23 volts. After a short time the battery voltage begins to increase rapidly and the charging current would soon decrease if the charging voltage was not raised. U_3 is then switched to the right, the motor is started and the charge of the battery is continued by means of the booster. At 560 volts total e.m.f.—corresponding to 2.5 volts per cell—the charge may be discontinued in general. In certain intervals it becomes necessary to overcharge the batteries to about 605 volts. After the charge of battery *II* is finished, the booster is stopped, the lever of the rheostat, *W*, is turned to the first notch and U_2 is turned to the left, after having adjusted the end-cell switches. The two batteries are now working in parallel and supply current to the lighting network. In order to charge the battery, *I*, U_1 is turned to the right and the end-cell switches turned to the last notch; U_3 is turned to the left and so on. By this method it is

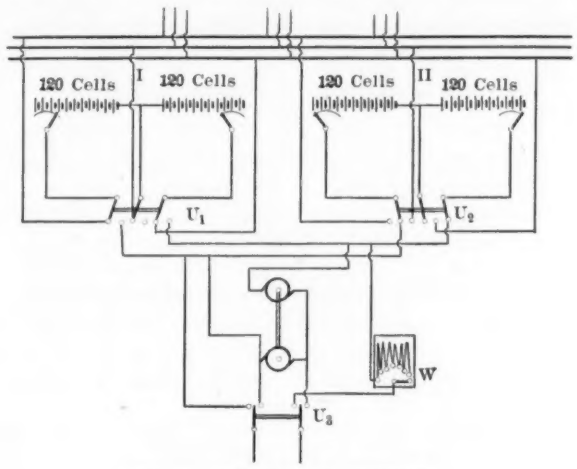


FIG. 3.—DIAGRAM OF CIRCUITS.

claimed that some 18 per cent of energy may be saved in comparison with the motor-generator system, while the first cost is about the same.—*Elek. Zeit.*, March 8.

Protective Apparatus.—NEALL.—An illustrated article in which the author discusses foreign practice in the design of protective apparatus for transmission lines. He first deals with the use of resistances, especially water resistances, describes methods of

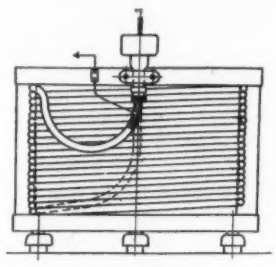


FIG. 4.—CHOKE COIL.

installations, and discusses at some length the development of cable protection in Europe. The cable choke coil, used at the junction of overhead lines and cable, as may be seen from the illustration, Fig. 4, consists of a coil of a cable or a drum of suitable material. A weak point in the insulation near the line connection is supposed to offer the proper path to earth if a disturbance reaches the coil and the inductance of this arrangement facilitates the throwing back of the disturbance. Special insulation is provided between turns, and the whole coil is insulated from earth. Cables which are not connected to overhead lines are, nevertheless, subject to static disturbances. These may arise from switching, from short-circuit, etc. For this purpose there is employed what is essentially an artificial weakening of the insulation at a known place or spot, and therefore any failure of the cable can be concentrated at these points. This arrangement is shown in Fig. 5 with a sort of spark-gap consisting of two concentric electrodes, *A* and *B*, which are separated from one another by a layer of insulation and an oil film, *C*. *A* is connected to the conductor to be protected, *B* is connected to earth. *E* is a sort of comb arrangement of metal to prevent the breaking of the ground connection in case the lead sheath should be punctured by a bad short-circuit. The action of this device is as follows: On the arrival of the static disturbance the layer of insulation is punctured and the oil pours in to smother the arc, so that the trouble is only of short duration. Fig. 6 shows the practical application of this method. Special tanks or receptacles are provided to contain these safety devices. In the ground lead of

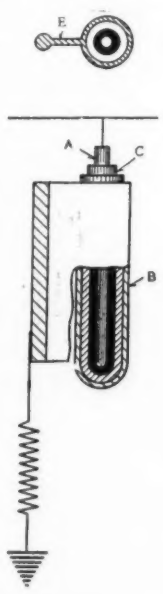


FIG. 5.—DIAGRAM OF TESTING APPARATUS.

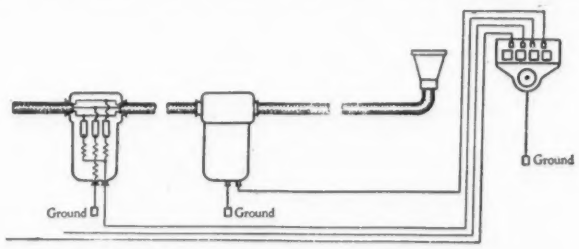


FIG. 6.—DIAGRAM OF TESTING CIRCUITS.

each fuse there is inserted a resistance to assist the oil in suppressing the arc. In order to learn at any time the exact locality of a breakdown signal wires are run from each tank to a bell and signal board. This is readily arranged to indicate the location of the trouble, which begins by the operation of the protective device, the current passing on this exciting a branch circuit, which in its turn operates the bell.—*Electric Journal*, March.

Electrophysics and Magnetism.

Break of an Inductive Circuit.—HUBBARD.—A theoretical and experimental paper on the conditions for sparking at the break of an inductive circuit. The author hoped to find relations such as indicated in some experiments by Lord Rayleigh, existing between the constants of an oscillatory electric circuit, as the primary of an induction coil, the initial current, and the velocity with which the contacts of the break are separated, when the conditions are just sufficient to prevent sparking at the break. By neglecting the "lag" effect in the spark, a theoretical relation is found, which may be roughly expressed by saying that the velocity of break necessary to prevent a spark will be proportional to the frequency of oscillation and a linear function of the maximum induced potential, the latter implying a linear relation between velocity of break and initial current. The necessary velocity of break was found experimentally to be: first, a linear function of the initial current; second, for given current, increasing in value in a manner consistent with the equation when the capacity is diminished; third, diminishing according to the equation when the inductance is diminished. The assumption that the lag of the spark might be neglected did not hold true. It is possible to place a limit on the velocity of break necessary to prevent a spark at the break of an inductive circuit, if we know the inductance, capacity and initial current. The necessary velocity will be lessened by any condition which causes the absorption of energy from the primary, such as a closed secondary, hysteresis, heat losses, etc.—*Phys. Rev.*, March.

Magnetic Field and Coronal Streamers.—TROWBRIDGE.—An illustrated account of experiments the chief results of which are as follows: When an anode in an X-ray bulb is also the end of a powerful electromagnet the application of the magnetic field results in the production of X-rays from a bulb which cannot be excited without the application of heat. When the cathode forms the magnetic pole a violet brush-like light appears on the cathode, on the side away from the electromagnet; while the fluorescent light is forced somewhat beyond the cathode. The use of Leyden jars in the case of low-potential coils greatly modifies the effect of the application of the magnetic field, while with coils giving sparks over 20 cm. with comparatively large Leyden jars in circuit the application of the magnetic field to either anode or cathode results in greatly increased production of X-rays. The application of a strong magnetic field at the anode with lines of force along the line of electric discharge forms a safe and useful method of regulation of X-ray bulbs. An electro-meter connected to the terminals of the exhausted tube shows a diminution of the apparent resistance of the tube when the anode is made the magnetic pole; and a rise in resistance when the cathode constitutes this pole. With Leyden jars in circuit the magnetic pole separates the oscillations, and rectifies the discharge to a certain extent.—*Am. Jour. of Science*, March.

Oscillations.—KAELAHNE.—The first part of a mathematical paper on electric oscillations in metallic tubes of ring form.—*L'Eclairage Elec.*, Feb 24.

Electrochemistry and Batteries.

Conduction and Radiation of Heat.—RICHARDS.—In the present installment of his serial on metallurgical calculations the author first gives the principles of heat conduction and radiation and applies these principles to the solution of various problems from practice; for instance, the losses of heat from pipes, etc. Tables are given of the constants determining the conduction and radiation of heat from various materials.—*Electrochem. and Met. Ind.*, March.

Pumping Chlorine.—ASHCROFT.—An illustrated article on the use of chlorine gas under moderate pressures in the chemical arts. The article contains much practical information based on actual experience of the author, which should be useful in electrolytic plants producing chlorine gas.—*Electrochem. and Met. Ind.*, March.

Units, Measurements and Instruments.

Accelerometers.—TROTTER.—An abstract of a paper on acceleration and methods for measuring it. The simplest of all methods

for measuring horizontal accelerations by the deflection of a plumb bob was experimentally demonstrated. The recording pendulum instruments of Mallock and Lanchester were mentioned, and actual records taken by the former were shown. Other types of accelerometers described were those depending on the alteration of levels of a liquid, of which one example is that of Kapp, in which a long tube with upturned open ends is used, fitted partly with mercury and partly with water, and the alteration in level in the longer branch is observed. Another form which the speaker had himself often used consisted of a bent tube nearly full of liquid, similar to a spirit level. This was particularly convenient for use in railway trains. The indications of these instruments are of course, affected by gradients as well as by acceleration, so the result obtained is rather a measure of the force acting on the train than of the acceleration. Thus, when a train is "coasting" down a grade, the bubble remains stationary at the zero, except for the small deflection due to friction, even though the speed is rapidly increasing. Again, when a car is standing on a grade, the bubble shows a considerable deflection, which is in reality a measure of the force of the brakes holding the car up. This somewhat detracts from the use of these accelerometers from a passenger's point of view, but for investigation of the actual power required for traction the accelerometer ignores the effects of gradients and attends to the propulsive power in a remarkable way. For many purposes the actual measurement of draw-bar pull by a dynamometer is the most suitable method.—Lond. *Elec.*, March 9.

Telegraphy, Telephony and Signals.

Electrocapillary Recorder.—An illustrated description of an electrocapillary recorder devised by Orling for recording submarine cable signals. The instrument works on the principle of the well-known capillary electrometer. The apparatus is shown in Fig. 7; a light lever, *L*, rests upon the top of the column of mercury, *M*, and when raised by the latter, tilts a little aluminum carrier suspended from a horizontal cord, *A*. The carrier supports a delicate siphon, *S*, the upper end of which dips into a bath of ink, while the lower end faces the tape, *T*, upon which the signal is recorded, the siphon being kept in slight vibration by a thread attached to a vibrator, *V*, consisting of a light spring arm bearing on a moving wheel with a serrated rim. The receiving circuit is completed between the two bodies of mercury (shown black) through the electrolyte, into which dip the capillary tubes, *CT*, and when a potential difference is established between the terminals, according to the well-known phenomenon, the mercury rises or falls in the capillaries, and, therefore, in the vertical tube. The application to the recording of wireless signals is described.—Lond. *Elec. Rev.*, March 2.

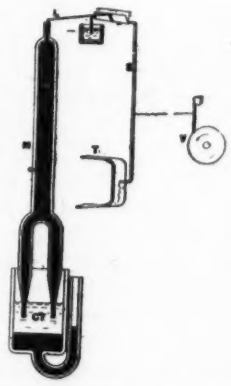


FIG. 7.—ELECTROCAPILLARY RECORDER.

Telephony.—Touanne.—The first part of a paper on the present status of telephony. In the present installment underground cable construction is discussed. The same issue contains statistical data on telephony and telegraphy in the Netherlands in 1904 and the official regulations on telephonic service between France and Italy.—*Jour. Tel.*, February 25.

BOOK REVIEW.

Experimental Researches on the Flow of Steam Through Nozzles and Orifices. By Prof. A. Rateau. New York: D. Van Nostrand Co. 76 pages, 4 figures and 4 plates. Price, $1.50.

In the design of the steam turbine where the pressure or potential energy of the steam must be changed to velocity or kinetic energy, the matter of the law of the flow of steam through the nozzles or channels in which this transformation must take place is evidently of prime importance. The art of turbine design being still young and the literature on the subject meagre and of questionable accuracy, it seemed to Prof. Rateau when he first undertook the study of this apparatus, some ten years ago, desirable to check experimentally the theoretically derived laws. The present volume, though hardly more than a pamphlet in extent, describes the apparatus he devised for that purpose, gives the readings taken during his one hundred and fifty odd trials therewith and his deductions therefrom. While the conclusions are naturally of chief value to the rather small circle of steam turbine designers, the paper as a whole is interesting as showing that laboratory experiments when planned and carried out by a scientist having as broad and trained an intellect as Prof. Rateau admittedly possesses, become of decided practical value to a machine constructor. The agreement found between theory and experiment is most gratifying.

Graphic Recording Electrical Instruments.

A complete line of accurate recording instruments has been developed by the Westinghouse Electric & Manufacturing Company the type of which is illustrated in the accompanying illustrations. These instruments are arranged to operate on the relay principle, the motor element actuating contacts, which in turn energize a pair of solenoids arranged to move the pen. They are designed for switchboard mounting and are enclosed in glass cases 13 in. by 16 in. by 9 in., with a removable high glass front giving access to the interior.

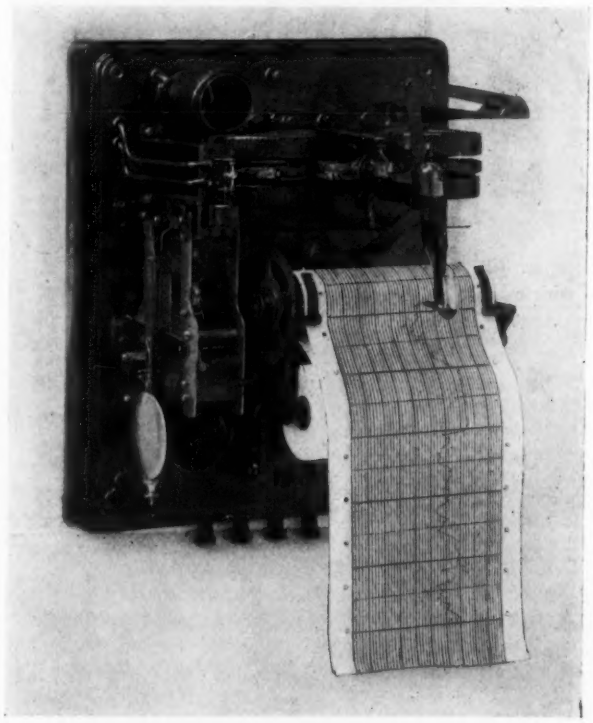


FIG. 1.—GRAPHIC RECORDER WITHOUT COVER.

The alternating-current motor, voltmeter and wattmeter coils are arranged in a manner similar to that of the standard line of Westinghouse precision instruments, and the registration is independent of frequency, external fields, temperature, voltage or wave form variation and equally correct on all power factors. The wattmeters are made for single-phase and polyphase circuits, the latter being correct at any degree of unbalancing.

The power factor and frequency meters have coils operating in the same manner as the corresponding Westinghouse indicating meters. The direct-current ammeters operate from shunts,

thereby avoiding the heavy wiring necessary for mounting on switchboards. Shunts already installed for indicating meters

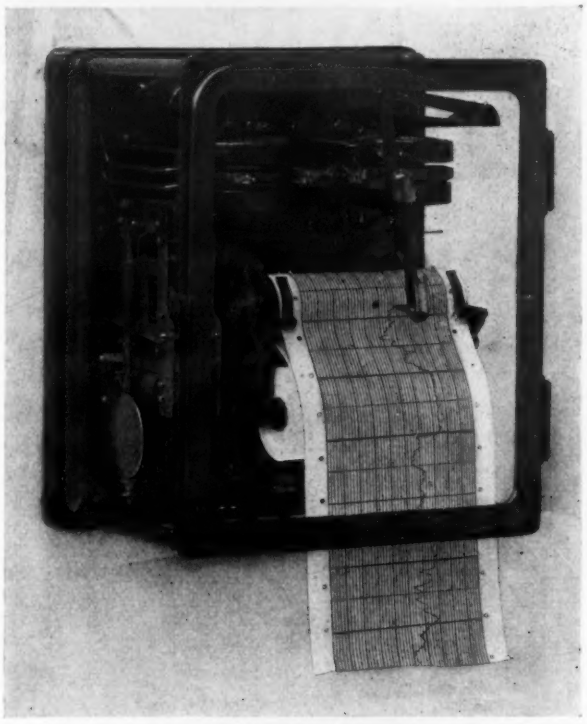


FIG. 2.—GRAPHIC RECORDER, WITH COVER.

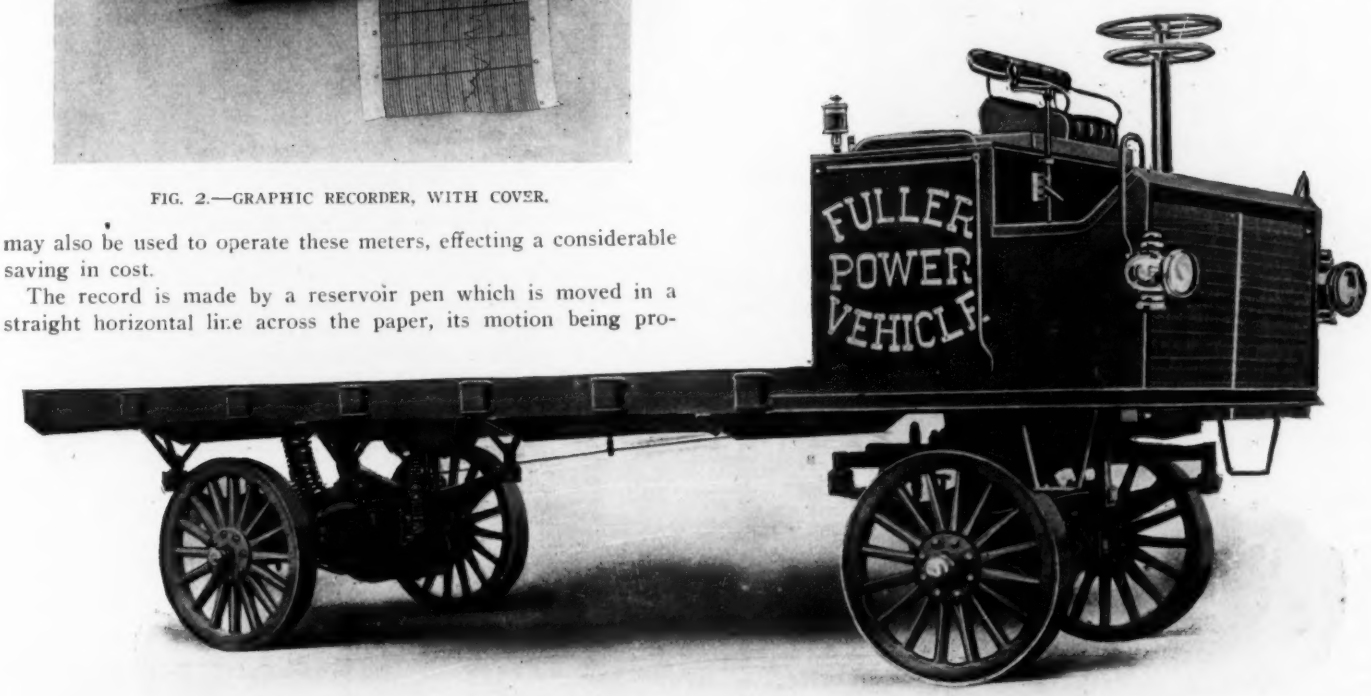
may also be used to operate these meters, effecting a considerable saving in cost.

The record is made by a reservoir pen which is moved in a straight horizontal line across the paper, its motion being proportioned to the quantity to be measured, thus giving a scale having rectangular co-ordinates. The reservoir will contain a month's supply of the ordinary writing fluid used. The quickness of the pen's motion and consequently its sensitiveness may be easily regulated. Thus the record may be made to follow the slightest variation of the load, or else to slur these slight irregularities and form a more even line. The registering paper may be driven at speeds varying from 2 in. to 8 in. per hour, and is arranged to unwind from a continuous roll. The speed may be changed very readily by inserting an extra set of gear wheels. Two inches per hour is the standard speed regularly furnished.

The recording paper is neatly printed, accurately ruled and punched, the width being approximately 6 in.—a deflection of 5¼ in. representing full load. It is furnished in rolls of sufficient length to last two months at 2 in. per hour. The clock is self-winding, is of high-power design and requires no attention. The meter coils consume no more energy than other Westinghouse switchboard instruments, thus insuring correct ratio on the meter transformer. The solenoids are energized from a separate source of current so as to relieve the meter transformers of the power required, and are of sufficient torque to render the friction between the pen and the paper negligible. The construction throughout is very rugged and compact, no delicate parts whatever being used.

The Fuller Power Vehicle.

An interesting heavy electric truck is being perfected by the Fuller Power Vehicle Company, of Detroit, under, Mr. Rudolphus R. Fuller, manager of the Fuller Company, well known as a manufacturer of engines and dynamos. An illustration of one of these vehicles is shown herewith. The initial power is a gasoline engine carried on the vehicle and direct-connected to a dynamo. This furnishes power to two electric motors, one of which is geared to each axle. The carrying platform of this truck is 20 ft. in length by 6 ft. in width, over all. Four feet of the length is taken up by the engine, generator, water tank, fuel tank and radiator. The balance of the platform (6 by 16 ft.) is available for load. The vehicle is rated as having a carrying capacity of from five to seven tons net. The weight of the vehicle is given as about 6,000 lb. It is constructed entirely of



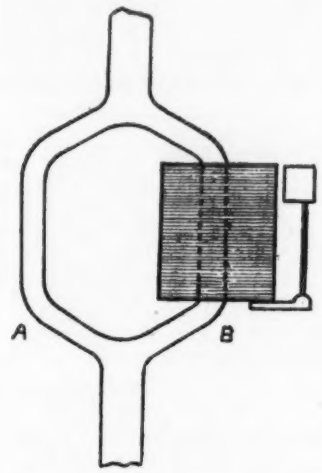
ELECTRIC POWER VEHICLE.

steel, even to the tires. It has the artillery type of wheels with bearings of navy bronze and capillary oiling arrangements. The framing is of steel channels and I-beams. The forward end of the vehicle is supported on a turntable with ball bearings. As the forward axle is driven as well as the rear axle, the operator can turn the vehicle completely around within its own length. By driving all four wheels much better traction is of course secured than where the rear wheels only are driven.

Time Lag for Circuit-Breakers.

The arrangement shown in the accompanying illustration is being used in England to obtain a time lag for circuit-breakers, by shunting an inductive circuit by a non-inductive one. Two circuits of thick copper rods are put in parallel, one of them being surrounded by a laminated horse-shoe magnet having an armature. A rush of current first goes through the non-inductive leg while the growth of current in the inductive leg is slow.

When the current becomes approximately equal in both legs there is only an exceedingly small force left to overcome the counter e.m.f. of the inductive leg. When the current in the inductive

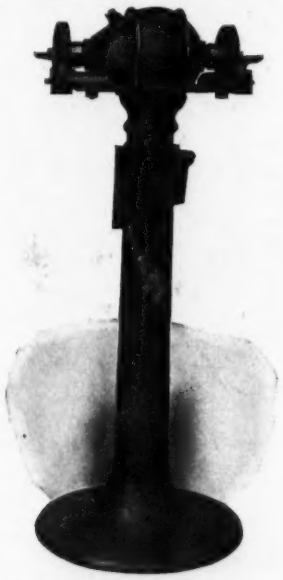


TIME LAG DEVICE FOR CIRCUIT-BREAKERS.

leg reaches a certain limit, the armature is attracted and makes contact, so as to work the circuit-breaker solenoid in the ordinary manner. The apparatus gives considerable time lag.

The Jenney Grinding and Buffing Motor Equipment.

The Jenney Electric Manufacturing Company, of Indianapolis, is putting out a very neat electric motor equipment for light service in grinding, buffing and polishing. The motor is mounted



GRINDING AND BUFFING MOTOR.

on a solid cast iron pedestal and has emery grinders or buffing wheels mounted on each end of the axle as shown in the accompanying engraving. The motor is for direct current and runs at 2,700 r.p.m. It is designed to carry two wheels of 8 in. diameter or under. It is furnished wired complete ready to connect to the power circuit with the starting resistance inside the pedestal and fully protected. The starting switch is mounted on slate attached to the pedestal convenient to the operator. The motor is, of course, provided with fully enclosed heads and dust-proof bearings. There are adjustable tool rests and water pots provided for each grinder. The arrangement is very neat as compared to belt-driven grinders requiring countershafts, high-speed belts and small driven pulleys.

Reflecting Shade and Fixture.

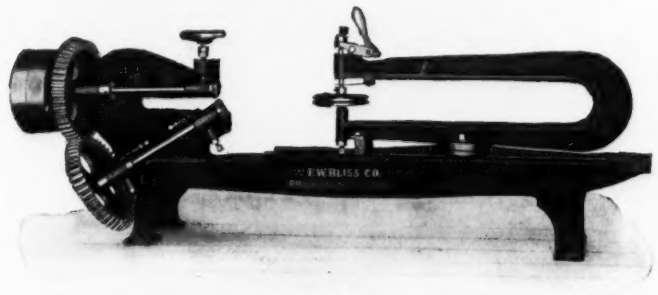
The Holophane Glass Company has placed upon the market a new fixture called the "Pagoda reflecting arc," shown herewith. A small compact cluster is used carrying small "Holophane

REFLECTING SHADE AND FIXTURE.

Pagoda" reflectors, surmounted by a large reflector of the same type. The combination gives a remarkably good distribution of light, and with its chain fixture presents, as will be seen, a handsome appearance. The shades, all consisting of clear glass, when lighted up present a brilliant appearance and add artistically to any place where they are used.

Shears for Armature Discs.

A special machine has recently been built by E. W. Bliss Co., Adams Street, Brooklyn, N. Y., for the purpose of cutting the



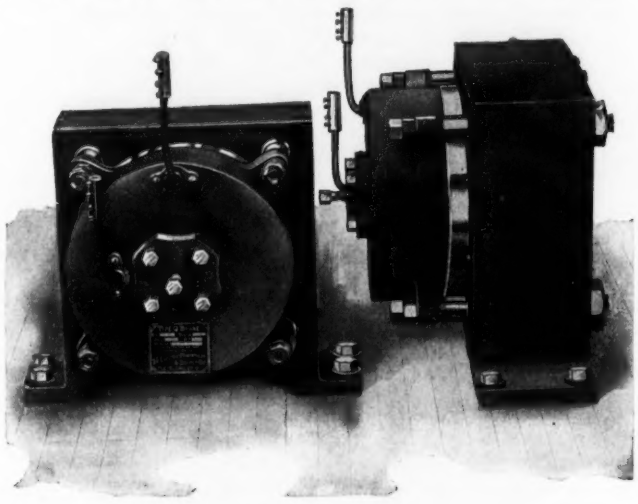
SHEARS FOR ARMATURE DISCS.

outside and inside of armature discs and other metal rings of similar nature. As shown in the engraving, it can be driven by either belt power from a motor, etc., or by hand.

The angular position of the lower cutters insures a cut equally clean on both the outside and the inside edge of the disc. The machine has cut gears and is very carefully built throughout so as to meet the demands for a tool of great accuracy. The circle clamping head is rigidly guided in the ways and is also provided with side adjustment to set the clamping discs off the center line to bring them into proper relation to the cutters, viz.: opposite the point of cut when making outside cuts, and to set them opposite center cutter for cutting rings. The shear will cut stock up to No. 20 B. W. G. and the capacity of the smallest and largest circles is 3 to 40 in.

Magnetic Crane Brake.

In all cases where electrically-driven machinery requires frequent stops and reversals, the facility and speed of handling material, and also the safety of the crane or other machinery employed, depends upon the accuracy and reliability of the brake. The brake shown in the illustration herewith has been designed to meet the exacting requirements of this service. The brake is released by an electromagnet through a diminutive air-gap, which operates quickly with a comparatively small current and without



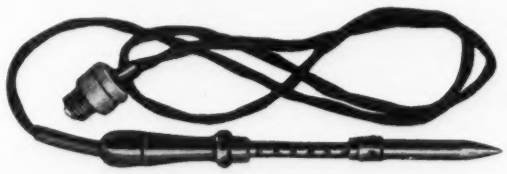
MAGNETIC BRAKE.

any hammer blow. The brake force is always maximum and equally effective in either direction of rotation.

The heat is carried away from the friction surfaces by the circulation of oil and is effectively radiated from the entire surface of the friction case. The brake is adjusted to release on one-half full load current of the motor as a maximum. Due to the large pole area, the brake does not drop back until the current has decreased to about 1/10 the full value, insuring a continued release of the brake until the current is entirely cut off. This brake is made by the Electric Controller & Supply Company, Cleveland, Ohio.

Electric Soldering Irons.

The accompanying illustration shows an electric soldering iron which has recently been placed on the market by the Ward Leonard Electric Company, Bronxville, N. Y. It is of compact construction and has been designed for close work, such as the

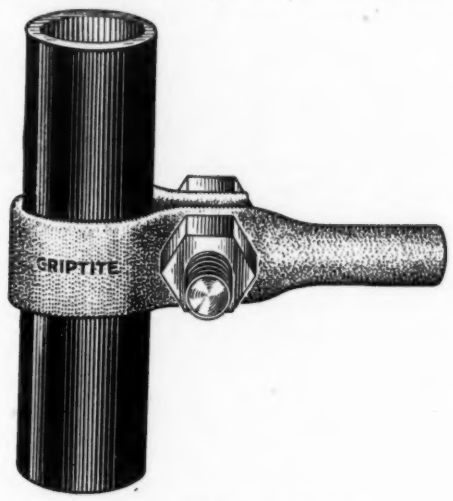


ELECTRIC SOLDERING IRON.

soldering of jacks in telephone switchboards. The device is so simple that a novice can use it without instructions. The heat generating resistance is hermetically sealed from the air by a protective heat-resistant coating, which does not depreciate in the practical use of the soldering iron. The heating unit is readily removable. Between the heating unit and the heat-emitting surface there is placed a solid material of good heat conductive qualities. There is no mechanism or automatically movable elements within the soldering iron. It is stated that there is no possibility of short-circuit of the heating unit against the working surface of the iron, even though the unit be burned out intentionally by subjecting it to a voltage twice as high as the normal. The soldering device is manufactured for use without exterior resistance upon a circuit of 700, 500, 220, 110 or 80 volts, according to the specifications of the purchaser.

Ground-Connection Clamp.

The recent decision of the insurance underwriters of the Philadelphia and Middle Division requiring in electrical installations the use of clamps for grounding metallic conduits or the



GROUND CONNECTION CLAMP.

metal sheaths of electrical cables, has led the Novelty Electric Company, Philadelphia, to design and manufacture a one-piece ground connection clamp, made of copper tubing, and of sizes to fit pipe from one-half to three inches in diameter, the lug taking a grounding wire of any size up to No. 4 B. & S. The clamp binds the wire very tightly, making a perfect electrical contact. This new type of clamp is shown in the accompanying illustration.

Ventilation of the Broadway Tabernacle.

Church auditoriums present a number of special difficulties in their heating and ventilating problems. In the case of the magnificent new Broadway Tabernacle, on upper Broadway, New York, there was one particular difficulty to contend with, namely, that under the auditorium there is a hall, which had to be left free of pipes and other objectionable features from an æsthetic point of view; in other words, there is no cellar in which pipes and ducts could be placed. A space between the auditorium and the ceiling below was provided for this purpose. This space is about three feet deep, but as it is due to the depth of the girders that carry the floor its usefulness for placing pipes and ducts was limited, as can readily be understood. After carefully considering all these points it was desired to use the blast system of heating, with mechanical exhaust and automatic temperature control for the auditorium, and direct radiators controlled by hand for the vestibules.

The seating capacity of this auditorium is 1,500. The apparatus was designed to supply 25 cu. ft. of air a minute per person to 1,600 persons, or a total of 40,000 cu. ft. of air a minute. It may be mentioned that in this case 25 cu. ft. a minute per person was about the maximum amount of air that could be introduced without causing drafts and noise, and this was introducing a large proportion of the air through top inlets. The entire use of bottom inlets would have been impossible without causing drafts, or considerably reducing the amount of air supplied.

A three-quarter housed centrifugal fan, built by the B. F. Sturtevant Co., Boston, Mass., is used to supply the air. This fan has a blast wheel 9 ft. in diameter by 4½ ft. wide, and is driven by a direct-connected motor. The fan is calculated to deliver 40,000 cu. ft. of air a minute at 130 r.p.m.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The continued winter weather retarded retail trade and affected jobbing sales and shipments, and building operations temporarily. The uncertainty as to the coal strike caused hesitancy in some lines of industry. Collections are slow owing somewhat to the effects of the weather conditions. Favorable features of the general business situation are the reported advance in wages in several industrial lines; the growth of the belief that there will be no coal strike and the strengthening of prices of leading staples, such as grain and cotton. General snow has put the winter wheat crop beyond harm, but planting operations are delayed. The pig iron market was dull, but there were many sales of steel rails, aggregating over 100,000 tons for the week. The steel rail production for 1906, it is estimated, will considerably exceed the large output of 1905. Some large contracts for structural material are pending, and a very heavy business in this line is looked for. The copper market was characterized by large and steady buyers of prime grade copper. Prices are 18⅝ to 18¾c. for Lake; 18½ to 18⅝c. for electrolytic and 18 to 18¼c. for casting stock. Machinery and machine tool manufacturers report an increasing business. Railway earnings are highly satisfactory and the ratio of net earnings to gross have never before been equalled. The reports for the first half of March show an increase of about 12 per cent in gross receipts as compared with the corresponding period last year. Gross receipts for January advanced 20.3 per cent over those of the same month in 1905, while the net receipts increased 44 per cent. In February gross earnings increased 25.6 per cent. *Bradstreet's* reports 170 business failures during the week ending March 22 as compared with 187 the week previous and 204 in the corresponding week last year.

LARGEST POWER STATION IN JAPAN.—That Japan is the center of electrical development in the East is evidenced by the installation of the largest electrical generating station in the Empire which the Tokio Electric Light Company now has under construction. This company already operates a steam-driven plant in the city of Tokio and the new plant will meet the increasing demand for power. The new plant, contracts for which have been recently closed, is located on the Tamagawa River, about twenty-five miles from Tokio, with which it will be connected by high-tension transmission lines, operating at a higher voltage than has been attempted heretofore in Japan. At the station the main generating apparatus will consist of five 3900-kilowatt Siemens & Halske machines directed connected to Escher Wyss water wheels. The generators will deliver 50 cycle current at 6600 volts. All high-tension switches are of the well-known General Electric H-3 oil type, motor operated and electrically controlled from a separate five-panel bench board. This system of remote control is also carried out for the rheostats and circuit breakers, which are also operated from the bench board. This switchboard will be furnished by the General Electric Company and is similar to one used in the New York Interborough station. The transformer equipment at the generating end of the line consists of nine 2000-kilowatt General Electric transformers, arranged for stepping up the voltage to 35,000 for transmission when connected in delta or 57,000 when Y-connected. For the present the current will be transmitted at about 40,000 volts, but eventually 60,000 volt transmission is planned. The receiving station will be located just outside the city and will contain the main step-down transformers, which are also furnished by the General Electric Company. The initial installation for the sub-station will consist of nine 1800-kilowatt units adapted to step-down the voltage from either 33,000 or 57,000 to 11,000 volts. The arrangement is thus suitable for the transmission voltage which is at present planned, and likewise will meet future needs when the transmission voltage is increased to 60,000. In the sub-station, as in the main generating plant, the switchboard will be furnished by the General Electric Company. From this station, on the outskirts of the city, all wires will be laid underground to various small distributing stations located about the city, transmission being at 11,000 volts.

MARCONI STOCK.—Considerable interest was aroused in Wall Street this week by the fact that stock of the Marconi Wireless Telegraph Company of America is at present being offered in widely distributed circulars at $100 a share, with interest at 5 per cent, guaranteed for five years by Reall & Co., of Philadelphia. These circulars state that the firm's contract to pay 5 per cent interest for five years is guaranteed by a bond of the Metropolitan Surety Company of New York and that the interest is payable at the West End Trust Company of Philadelphia. The Marconi Wireless Telegraph Company of America officially disclaims all connection with Reall & Co., of Philadelphia. An officer of the company states that the offer of its stock is being made without authority and against the wishes of the company. Officers of the Metropolitan Surety Company said that they objected to the form of the circulars being sent out by Reall & Co. because from them the inference might be drawn that the Metropolitan Surety Company was guaranteeing 5 per cent interest on the stock of the Marconi Wireless Telegraph Company. The Metropolitan Surety Company, it was added, is acting in no way for the Marconi Wireless Telegraph Company, and that its only undertaking in the matter of this interest is directly with the firm of Reall & Co. The curb quotations on Marconi stock are $35 asked and $33 bid.

THE H. C. K. COMPANY has just been organized with offices for the present at 45 Broadway. The corporation will make high grade electrical and mechanical specialties, devoting attention chiefly to the electric lighting field, and has already a number of meritorious novelties ready for the market. The president of the company is Mr. J. H. Hallberg, well known in the central station field and a prolific inventor, whose name is associated with some admirable specialties. Mr. H. B. Coles is the vice-president. Mr. P. H. Klein, Jr., is the secretary and treasurer, and is a man who has an unrivalled experience as a practical manufacturer in this field, dating back to the earlier Bergmann, Edison, Sprague, Interior Conduit and "G. I." days. He will virtually be at the head of the shop management. Mr. George H. Benjamin, the well-known patent attorney, will have charge of the legal and patent department. He has been associated with several of the interests above named, as well as with the Siemens & Halske, Ganz, Bridgeport Brass, Ansonia Brass & Copper, Standard Oil, American Sugar Refinery and other companies. This is a strong combination of engineering and technical talent, and a good deal will be expected of the new concern.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company's instrument statement for February and two months, ending February 28, 1906, compares as follows:

February—	1906.	1905.	1904.
Gross output,	161,775	134,301	84,402
Returned.....	48,842	47,577	37,093
Net output.	112,933	86,724	47,309
January 1 to February 28—			
Gross output.	338,382	264,935	175,046
Returned.....	112,066	85,277	73,947
Net output.	226,316	179,658	101,099
Total outstanding	5,924,574	4,660,222	3,880,616

ALLIS-CHALMERS MOTOR OUTFITS.—The Milwaukee Coke & Gas Company has recently purchased a number of Allis-Chalmers direct-current motors. The new outfit will include an aggregate of a hundred horse power. The Allegheny County Light Company of Pittsburg, Pa., is a recent purchaser of two hundred horse power in Allis-Chalmers induction motors. The Glidden Varnish Company of Cleveland, O., has recently placed orders with the Allis-Chalmers Company for a number of motors, ranging from 5 to 20 hp.

SALE OF NATIONAL ELECTRIC PLANT.—A despatch from Milwaukee, Wis., says the plant of the National Electric Company, including all assets, was sold March 26 at the office of John S. Maxwell, referee in bankruptcy, to Charles L. Sullivan of Chicago for $500,000. The statement of Receiver John I. Beggs showed assets of $1,350,691 and liabilities of $1,242,000. Creditors will, it is stated, receive approximately 40 per cent of their claims.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was inactive and professional in character in the early part of the week, but later it developed strength, and sentiment changed from depression to renewed confidence in the maintenance of present prices. The United States Steel stocks were quiet, notwithstanding the very favorable annual report for 1905. Electric securities were weak and little business was done in them. Westinghouse closed at 161; General Electric at 168½—a decline of ½ point—and Allis-Chalmers 21⅛ and 58 for common and preferred, respectively. The last two quotations represent net losses of ¾ on common and 1¾ points on preferred. Brooklyn Rapid Transit closed with a net loss of 1⅛ points, the last quotation being 83, but Metropolitan Street Railway made a net gain of ⅜, closing at 112, ex-div. Interborough-Metropolitan common is quoted at 50⅜ on the curb and 4½s at 90½. A net advance of ¾-point is recorded in Western Union, which closed at 92½, and of ¼-point for Mackay Companies—on the curb—the closing quotations being 59½. American Locomotive, common and preferred, close at 68¼ and 116⅞, respectively. Transactions on the curb during the week were very small, most of them representing manipulations. Efforts were made to stimulate interest in the copper shares, but they failed. Following are the closing quotations of March 27:

NEW YORK

	Mar. 20	Mar. 27		Mar. 20	Mar. 27
Allis-Chalmers Co.	21	21⅛	General Electric	167	167
Allis-Chalmers Co. pfd.	57¾	57	Hudson River Tel.	...	...
American Dist. Tel.	30	30	Interborough Rap. Tran.	227⅛	228
American Locomotive	69¼	68	Mackay Cos.	59⅝	59½
American Locomotive pfd.	116¼	115	Mackay Cos pfd.	74	72½
American Tel. & Cable	92	92	Marconi Tel.	...	...
American Tel. & Tel.	136	138	Metropolitan St. Ry.	113	113
Brooklyn Rapid Transit	83¼	84	N. Y. & N. J. Tel.	...	...
Electric Boat	27	27	Western Union Tel.	91	92
Electric Boat pfd	65	65	Westinghouse com.	161	158
Electric Vehicle	17	12	Westinghouse pfd.	...	...
Electric Vehicle pfd.	16	15			

BOSTON

	Mar. 20	Mar. 27		Mar. 20	Mar. 27
American Tel. & Tel.	137	138¼	Mass. Elec. Ry. pfd	68⅝	69
Cumberland Telephone	117¼	...	Mexican Telephone	...	4½
Edison Elec. Illum.	...	247½	New England Telephone	140	139
General Electric	...	167⅜	Western Tel. & Tel	...	...
Mass. Elec. Ry.	20	19¾	Western Tel. & Tel pfd.	...	...

PHILADELPHIA

	Mar. 20	Mar. 27		Mar. 20	Mar. 27
American Railways	51	51	Phila. Electric	7¾	7⅞
Elec. Co. of America	11⅜	11¼	Phila. Rapid Trans.	29⅛	27¾
Elec. Storage Battery	79	78	Phila. Traction	99¾	99⅛
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Mar. 20	Mar. 27		Mar. 20	Mar. 27
Chicago City Ry.	150	155	National Carbon	91	86
Chicago Edison	155	148¼	National Carbon pfd	118	116
Chicago Subway	49	49	Union Traction	...	...
Chicago Tel. Co.	115	117	Union Traction pfd	...	...
Metropolitan Elev. com.	25⅛	26⅛			

DIVIDENDS.—The directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 2½ per cent on the preferred, the assenting and the non-assenting stocks payable April 10. The National Carbon Company has declared a dividend of 1 per cent on its common stock, payable April 14. The Bell of Missouri Telephone Company has declared a regular quarterly dividend of 2 per cent, payable April 2. The Chicago Telephone quarterly dividend of 2½ per cent is payable March 31. The directors of the Mexican Telegraph Company have declared the regular quarterly dividend of 2½ per cent on the stock, payable April 13, to stockholders of record March 31. The directors of the Hall Signal Company have declared the regular quarterly dividend of 1½ per cent on the common and the regular annual dividend of 6 per cent on the preferred, both payable April 2.

WESTINGHOUSE CAPITAL INCREASE.—The stockholders of the Westinghouse Electric Company, at a special meeting at East Pittsburg on March 26, voted unanimously to increase the capital stock from $25,000,000 to $50,000,000. The recent action of the board of directors, by which the company issued $15,000,000 convertible gold bonds of $1,000 each was also ratified. The attendance of stockholders was large, 389,543 shares being represented. The next annual meeting will be held in July, when a full financial statement of the company's business will be made.

THE WEST INDIA ELECTRIC'S ANNUAL.—The first annual report submitted by the new board of directors of the West India Electric Company, of Jamaica, at the annual meeting held in Montreal, Que., Canada, a few days ago, showed that very marked progress had been made. The gross earnings for the year amounted to $139,762.33, an increase of $8,596.08, or 6.55 per cent over the previous year. The net earnings amounted to $34,242.57, an increase of $6,111.39, or 10.09 per cent. The entire net profits have been placed to the credit of surplus account, and from that account has been written off for reinforcement of feeders, depreciation in value of stores, bad debts and accidents, the sum of $5,440.44, leaving a balance to the credit of surplus account of $142,883.04. The indebtedness to the Bank of Montreal has been reduced from $58,288.54 to $23,426.38. The following board of directors was elected: James Hutchinson, president; C. J. Fleet, K. C., vice-president; Hon. David MacKeen, W. Graham Browne, Henry Holgate, G. M. Webster and A. R. Oughtred. The earnings were chiefly from traction, but the electric lighting department showed earnings of $3,191. The company is now taking over the electric light system at Kingston, of the Jamaica Electric Light & Power Company, Limited.

ELECTRIC STORAGE BATTERY.—The Electric Storage Battery Company reports a most prosperous year in 1905. The income account shows as follows for the twelve months ending December 31:

	1905.	1904.	1903.
Gross	$1,467,486	$1,344,536	$1,761,058
Expenses	389,032	378,877	352,048
Net	$1,078,454	$965,659	$1,409,010
Other income	135,533	117,249	92,581
Total income	$1,213,987	$1,082,908	$1,501,591
Dividends	812,440	812,435	812,435
Surplus	$401,547	$270,473	$689,156

The principal items for the year compare as follows:

	1905.	1904.	1903.	1902.
Net	$1,213,987	$1,082,908	$1,501,591	$1,113,199
Dividends	812,440	812,435	812,435	812,427
Surplus	$401,547	$270,473	$689,156	$300,772
Previous surplus	3,198,864	2,972,633	2,323,354	2,022,582
Adjustments	43,416	44,243	39,877	.....
Total surplus	$3,556,994	$3,198,863	$2,972,633	$2,323,354

WASHINGTON RAILWAY & ELECTRIC.—The income account of the Washington Railway & Electric Company for the year ended December 31, 1905, compares as follows:

	1905.	1904.	1903.
Gross	$2,905,907	$2,644,360	$2,462,295
Expenses	1,478,466	1,355,822	1,328,052
Net	$1,427,441	$1,288,538	$1,134,243
Other increase	50,553	49,024	32,906
Total increase	$1,477,994	$1,337,562	$1,167,149
Interest and taxes	999,455	981,039	945,270
Surplus	$478,539	$356,523	$221,879

THE CENTRAL HOME TELEPHONE COMPANY, having a capital of $5,000,000, has been organized for the purpose of taking over the properties of fifteen or twenty independent home telephone companies in Kentucky and southern Indiana. The new organization, while primarily a holding company, is also a building and organizing company. E. L. Barber, of Massillon, O., is president of the company; Joshua D. Powers, of Louisville, is treasurer, and J. L. Monteith, of Bloomington, Ind., is secretary.

SOUTHEASTERN TELEPHONE.—The proposed increase of the stock of the Southeastern Telegraph and Telephone Company from $10,000,000 to $20,000,000 was authorized at the meeting of stockholders recently. Subsequently the stockholders held their regular annual meeting and re-elected the retiring directors.

WHATCOM COUNTY LIGHTING.—A mortgage for $2,500,000 to secure 5 per cent thirty-year bonds has been given by the Whatcom County Railway & Light Company, of the State of Washington, in favor of the City Trust Company of Boston. The mortgage covers all the company's property.

WISCONSIN MERGER.—Chicago capital is interested in the consolidation of the La Crosse (Wis.) Street Railway Company, La Crosse Gas & Electric Company, and La Crosse Hydro-Electric Light & Power Company, the combination of these public utilities involving $5,500,000.

CENTRAL & SOUTH AMERICAN.—The Central & South American Telegraph Company for the year ended December 31, shows gross, $1,316,249; net, $841,926; dividends, $463,536; surplus, $378,390. The gross was $170,000 better than 1904; and the surplus is nearly doubled.

GENERAL NEWS.

Construction News.

TEXARKANA, ARK.—The Texarkana Telephone Company contemplates improvements which will cost about $35,000.

EUREKA SPRINGS, ARK.—The City Council of Eureka Springs has granted the Citizens' Electric Company 81 years additional to its franchise for its lighting plant, which makes the franchise expire at the same time its electric railway franchise does.

ALBERTVILLE, ALA.—Edgar O. McCord, of Albertville, writes that the Fall City Hotel, Power & Mineral Water Company will develop the water power at Fall City at a cost of $35,000. Bids for construction will be received about July 1. Engineer, E. B. Kay, of Tuscaloosa.

RIVERSIDE, CAL.—The Riverside Power Company is said to have been purchased by the Pacific Light and Power Company of Los Angeles.

OAKLAND, CAL.—The Oakland Gas, Light & Power Company has begun the work of placing its wires underground in the business section of the city.

OAKLAND, CAL.—The Home Telephone Company of Alameda County, which is backed by the same financial interests that are behind the Home Company of San Francisco, was granted a franchise in Oakland for fifty years.

RED BLUFF, CAL.—The application of the Red Bluff & Redding Railway Company for a franchise to build a line down Main Street has been refused. After this action by the trustees, Chief Engineer W. D. Nicholson filed a petition formally asking for a franchise to build the road on Madison Street.

EUREKA, CAL.—Sealed bids will be received up to April 9 for a 50-year franchise applied for by the North Mountain Power Company for erecting and maintaining wires and poles for the transmission of electric heat and light over streets and roads in the town of Fields Landing. F. M. Kay is deputy clerk.

LOS ANGELES, CAL.—Senator Flint has introduced a bill at Washington granting the Edison Electric Company of this city permission to occupy certain lands for electric power plants in the San Bernardino, Sierra and San Gabriel forest reservations for a term of years, to be determined by the Secretary of Agriculture.

RIVERSIDE, CAL.—The Riverside Trust Company, the Riverside Water Company, the Riverside Land & Irrigation Company, and the the Chase Nursery Company are interested in the construction of an electric plant to supply power to the Santa Ana Valley. The plant will cost about $250,000.

SONORA, CAL.—The Tuolumne Electric Company is at present installing machinery at its electric plant on the Tuolumne, about two miles below the mouth of the Clavery River. The plant will furnish 2400-hp, and will supply power to the mines in the Big Oak Flat and Groveland district and also to a group of mines, which will be operated by the company.

SAN FRANCISCO, CAL.—The Central California Traction Company, which has just built 9 miles of electric railway in Stockton, is to immediately build a line 18 miles long between the latter city and the town of Lodi. The company has decided to issue $1,500,000 worth of bonds, the proceeds from which will be used for extensions, including the Lodi line.

PALO ALTO, CAL.—A press report states: The monthly report of the City Clerk developed the fact that a large number of the regular customers of the municipal plant were far behind in their payments, and the Town Board immediately passed resolutions calling upon the City Clerk to enforce the ordinance. There is still $1,600 due the city plant for light and water rentals from 863 customers.

SAN FRANCISCO, CAL.—The Weed Lumber Company, San Francisco, recently ordered Allis-Chalmers electrical machinery for Marysville, Cal. The new outfit consists of a 700-kw belted alternator and a small belted exciter, together with a large number of induction motors to be built at the Allis-Chalmers works, Cincinnati, ranging from 3 to 75 hp each, with a total aggregate of 248 hp.

SAN FRANCISCO, CAL.—Allan Pollok has resigned his position as manager of the San Francisco Gas & Electric Company, and, with Frank J. Kilpatrick of New York, representing Eastern capital, is said to be working up a proposition for selling a large water supply from the Stanislaus and Calaveras rivers to the city of San Francisco. In connection with the project is a water power capable of developing 20,000 hp.

OAKLAND, CAL.—The California Gas & Electric Corporation is preparing to build a new pole line along the foothills from Walnut Creek, back of Mount Diablo to Oakland, instead of through the city of Berkeley as at present. This will bring the double 60,000-volt transmission line of the Bay Counties system directly into Oakland and avoid passing through residence streets as is done now. Two carloads of large porcelain insulators have already arrived for the new line.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation is rushing the work of installing the new Deer Creek power-house at Cooper's sawmill with all haste. The site for the power-house is being prepared, and there will be considerable blasting necessary. A great quantity of concrete will be used, as the power house will be built of cement, steel and stone. The plant will have a capacity of some 8,000 hp, which is four times the amount generated at the Rome power house.

UKIAH, CAL.—The Snow Mountain Power & Water Company, owned by San Francisco capitalists, is preparing to supply water and power to Mendocino, Lake, and parts of Napa and Sonoma counties. The extensive works of the company will be finished about November 1. The capital of the company is $5,000,000, and the officers are: President, Charles N. Felton; vice-president, W. W. Van Arsdale; directors, George W. Scott, Timothy Hopkins and F. D. Madison, representing the Pillsbury interests. A tunnel one mile long has been bored connecting the Eel River valley with Potter valley, which is 450 ft. lower. Through this tunned water will be carried to the power plant at the mouth of the tunnel, where 20,000 hp will be developed. The water then will be carried in ditches to the Potter, Ukiah and Sonoma valleys for irrigation.

DURANGO, COL.—The Animas Power Company, which has already installed machinery in its big power plant building above Rockwood, and is in readiness to supply electric power for the mines and mills of the San Juan, announces that $600,000 more will be expended this year in enlarging the plant.

RED BLUFF, COL.—Negotiations have been concluded for the right of way of the new power line which will be constructed by the Northern California Power Company from its plant at Volta, near Manton, in this county, to Chico, and thence to the new sugar refinery at Hamilton. An auxiliary line for light and power will be built for the settlement at Los Molinos, and electricity will be supplied to the various subdivisions for irrigation and lighting. The land concern has also agreed to take 200-hp for manufacturing and pumping.

WILLIMANTIC, CONN.—Surveyors have completed to Storrs the survey of the proposed trolley line between Willimantic and Stafford. The route runs through Mansfield Center, Storrs and near Gurleyville, Chaffeeville and Hanks Hill.

NORWICH, CONN.—The plan to erect the power house of the Norwich & Westerly electric railway at tidewater has been abandoned and it has now been decided to build the plant at Hallville, near Poquetanuck, about four miles from Norwich.

NEW LONDON, CONN.—The Connecticut Railroad Commissioners have approved the plans and the method of construction of the new Preston, Ledyard & North Stonington Railway, which is to extend from Norwich to the northerly part of the village of Westerly. The new road will pass through the village of Old Mystic and Ledyard to Norwich and from there will go down along the Thames to New London.

NEW LONDON, CONN.—Plans which involve the relaying of the entire street railway track of New London, replacing the present 4-inch 48-pound rails with standard 8-inch 78-pound rails, pushing to completion the contemplated Jefferson Avenue loop, also a loop through Truman Street to Blackhall, the double-tracking of the Main Street line and also of the Bank Street and Montauk Avenue lines, were outlined by First Vice-President Townley and General Manager John K. Punderford of the Consolidated Railway at a conference held with the street committee at the office of Mayor Bryan F. Mahan in City Hall a few days ago.

WASHINGTON, D. C.—The work of increasing the capacity of the power house of the Washington, Alexandria & Mount Vernon Railway at Four Mile Run, Va., has been started. No change is to be made in the interior of the generator and engine room, there being ample space in the building for the installation of a new 1,500-hp turbine engine and two generators. This addition to the plant is made necessary by the increased number of trains that will be put in service during the coming summer, and by the fact that the power to light the new Luna Park and to run the attractions there will be furnished from the Four Mile Run plant.

WASHINGTON, D. C.—Bids will be received until April 10 at the Bureau Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C., and Norfolk, Va., a quantity of naval supplies as follows: Schedule 431, water pipe and fittings, etc.; schedule 432, generating set, electrical supplies, etc.; schedule 433, electrical cable, electrical supplies, hydraulic jacks, pine, sheet copper, tool steel, bar iron, roof trusses, pipe and fittings, steam traps, etc.; schedule 434, circuit-breakers, pine, ingot copper, steel angles, etc.; schedule 435, twist drills, boiler test pump, sheet copper, angle iron, galvanized sheet steel, etc.; schedule 436, bolts, pig lead, c. i. pipe and fittings, valves etc.; schedule 437, pump, sheet brass, blacksmith's forges, pipe fittings, gate valves, angle valves, etc. Also until April 24 to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of naval supplies as follows: Schedule 440, concrete mixer, electrical conductor and supplies, enameled iron conduit, corrugated tiles, iron pipe, foundry facings; schedule 441, steam pump, drills, etc. Applications for proposals should designate the schedule desired by number. H. T. B. Harris, Paymaster-Gen., U. S. N. Bids will be received until April 20, at the office of the Secretary, Smithsonian Institute (R. Rathburn, acting

secretary), to furnish to the Smithsonian Institute, U. S. National Museum, International Exchange, Bureau of American Ethnology, National Zoological Park, and Astrophysical Observatory during the fiscal year ending June 30, 1907, the following: Plumbing and electrical supplies; building materials, etc.

CHIPLEY, GA.—A committee of citizens has been appointed with Colonel T. T. Murrah as chairman, to ascertain the possibility of organizing a company to construct water works and an electric light plant.

MARIETTA, GA.—The Georgia Manufacturing & Public Service Company, of Marietta, Ga., has purchased through the New York office of the Allis-Chalmers Company, one 18x36x42-in. heavy duty, cross-compound engine for use in that city.

ROCKMART, GA.—Bids will be received until April 9 by A. H. Graefer, clerk of the Council, for constructing an electric light plant, embracing boiler, high speed engine, heater pumps, switchboard, series arc light system, electric and steam material and building. Jos. M. Roman & Company, Engineers, Century Building, Atlanta, Ga.

NAMPA, IDA.—A. K. Stoddard has been granted a franchise to erect telephone poles and wires for an independent telephone company.

CUBA, ILL.—It is reported that a municipal electric light plant will be constructed here.

ALEXIS, ILL.—Fire destroyed the electric heating plant at this city, causing a loss of $3,500.

PEORIA, ILL.—A petition is being signed by the villagers for the establishment of a municipal plant and will be presented to the council at its next meeting.

ROSELAWN, ILL.—At a special meeting of the Village Board of this city the Interstate Traction Company was granted a franchise to build and operate its line through the village.

SPRINGFIELD, ILL.—The Springfield Consolidated Railway Company will extend its line on South Grand Ave., to the site of the proposed new club house to be erected near the Leland Hotel farm; an outlay of $16,000 will be involved.

CHICAGO, ILL.—The committee on local transportation of the City Council has recommended the passage of the ordinance permitting the Humboldt Park branch of the Metropolitan Elevated to be extended to the city limits at Seventy-second Avenue.

BARTLETT, ILL.—The Chicago & Oak Park Elevated Railway Company, of Chicago, has submitted plans to the promoters of the proposed new electric lines between Elgin and Chicago, for a Lake Geneva branch, which will pass through Desplaines, Palatine and Lake Zurich.

SPRINGFIELD, ILL.—A certificate has been filed with the Secretary of State for an increase of capital stock by the Elgin & Belvidere Electric Railway Company from $2500 to $1,200,000. The company is chartered to construct an electric railway from Elgin to Belvidere.

MATTOON, ILL.—The announcement is made of the consolidation of the Mattoon Telephone Company, the Coles County Telephone Company, and the Charleston Telephone Company, all three companies being taken over by the Coles County Telephone & Telegraph Company, which was recently incorporated for $100,000.

EAST ST. LOUIS, ILL.—Announcement was made March 23 of the merging of the East St. Louis & Suburban Railway and the Alton, Granite City & St. Louis Company, which connect St. Louis with a score of Illinois towns and cities within a radius of 40 miles. The new company will be incorporated with a capital stock of $14,000,000.

TROY, IND.—The firm of Gardner & McLaughlin has been granted the right to erect and operate an electric light plant in the town of Troy.

HAMILTON, IND.—This city has decided to issue bonds in the sum of $1,800, payable in ten years at 5 per cent interest, for the erection of an electric light plant.

SHELBURN, IND.—This city is to have a new electric light plant. The town board granted a franchise at its last meeting to a company composed of Thos. Duncan and others.

INDIANAPOLIS, IND.—The Indianapolis & Frankfort Traction Company has been granted a franchise by the town board of Sheridan to build an interurban line from Carmel north to Frankfort.

MT. VERNON, IND.—The election to vote a subsidy in aid of the construction of the Vanderburg & Posey County Electric Railway in Smith township on March 24 was carried in favor of the tax.

GOSHEN, IND.—It is stated that the Central Union (Bell) Telephone Company will expend about $50,000 in installing a complete new plant at Goshen. The plans have been approved and work will begin soon.

INDIANAPOLIS, IND.—The promoters of the Belt road, who are planning to encircle Indianapolis, held a meeting in this city March 23, at which it was decided to effect a permanent organization and secure a survey at once. The cost of road is estimated at $2,500,000.

JEFFERSONVILLE, IND.—It is announced by Charles Fiske, chief engineer of the Louisville & Indianapolis Traction Company, that the road, proposed to connect Louisville and Indianapolis, has been financed. The plan is to build from Sellersburg to Seymour, a distance of 42 miles.

FORT WAYNE, IND.—The proposition of the Home Telephone Company to take over the National Telephone Company, owning 1,000 miles of toll line and exchanges in Kendallville, Eturgis and other points, has been accepted. The price is $90 on a capital stock of $250,000. The National people will accept $225,000 in 6 per cent preferred stock of the Home Company.

KOKOMO, IND.—President Marott of the Kokomo, Marion & Western Traction Company is not only furnishing electricity for lighting and cooking purposes, but is to supply the Leach Stone Quarry Company with power for a motor to drive pumps now at work draining the water from the quarry. Upon the completion of this work the company will use the motor to secure power for the crushing plant. The Traction Company is also arranging to install motors at the big brick plant south of the city.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company, on the completion of the additions to its present power house now under way, will install for light and power a 1000-kw Allis-Chalmers turbo-generator unit. The new unit will generate current at 60 cycles, two phase, 2300 volts. Other electrical machinery, consisting of a 30-kw direct-connected engine-type exciter set, a 35-kw "Bullock" motor-generator set, together with switchboards, condensers and piping, will also be furnished by the Allis-Chalmers Company.

WYNNEWOOD, I. T.—N. S. Sherman, of Oklahoma City, Okla., has secured the contract for constructing water works and an electric light plant for $26,046.

TAHLEQUAH, I. T.—Frank R. Lewis, of Tahlequah, president of the Illinois River Light & Power Company, writes that it is proposed to develop the water power of Illinois River near Tahlequah, at a probable cost of $100,000.

FORT DODGE, IA.—The Fort Dodge Light & Power plant was sold to a syndicate in Grand Rapids, Mich., for $256,000.

MANCHESTER, IA.—The Manchester Light, Heat & Power Company will increase its capital stock from $15,000 to $30,000.

RED OAK, IA.—L. M. Griffin & Son, owners of the Botna Valley Mills, are contemplating the promotion of a scheme to provide electric lights for Elliott and Griswold.

DES MOINES, IA.—Lewis B. Why, of Fort Wayne, Ind., and Richard Townsend, of Decatur, Ind., who are said to be interested in the Indianapolis & Northwestern and the Indianapolis & Eastern Companies, were in Des Moines recently as the prospective promoters of an electric railway from Des Moines to Ottumwa.

HUTCHINSON, KAN.—The directors of the Hutchinson Interurban Railway Company have bought a site for a power house and car barns. Work is to start at once on the construction of the city electric line to be extended later both east and west to the country.

TOPEKA, KAN.—The Missouri & Kansas Telephone Company is to expend $150,000 in improving its systems at Topeka. A new switchboard with a capacity of 9,600 lines will be installed in the exchange building at 211 West Sixth Street. The building itself is to be enlarged.

LEITCHFIELD, KY.—The City Council has passed an ordinance offering for sale a franchise for an electric light plant.

LOUISVILLE, KY.—A new ordinance has been introduced in the lower board of the General Council asking that a franchise be sold covering the whole city instead of only a restricted portion of it. The ordinance stipulates at what price electricity shall be sold by the company and the manner in which the conduits shall be laid and poles erected. It also states that the purchaser shall furnish to the city streets lights at $74 per month a light, which is $10 less than the city is now paying for lights. The ordinance was referred to the Revision Committee and ordered printed.

HOMER, LA.—The Town Council has granted Edward Sawyer, of Ruston, a franchise for an electric light plant at Homer.

PORTLAND, ME.—All the machinery has been purchased for the new substation of the Portland Lighting & Power Company.

CUMBERLAND, MD.—The Legislature has authorized the merger of the Westernport & Lonaconing and the Cumberland & Westernport Electric Railways.

NORTH ATTLEBORO, MASS.—The citizens have voted to appropriate $35,000 for enlarging the municipal electric light plant.

BROCKTON, MASS.—A proposition to purchase the electric light and the gas plants of this city has been presented to the Common Council.

WINCHESTER, MASS.—An investigating committee has been appointed to report at a future town meeting on the construction of a municipal electric light plant.

TEMPLETON, MASS.—The committee appointed to investigate the electric lighting project has reported to the town meeting in favor of establishing a municipal lighting plant, the power to be purchased from the Gardner Electric Light Company.

LEXINGTON, MASS.—At a recent town meeting a motion was presented, advocating a 5-year contract with the Lexington Gas & Electric Light Company, and that all arc lamps (39) be discontinued and replaced by 117 incandescent lamps. The matter was referred to the finance committee.

MILFORD, MASS.—It is reported that when the present arrangement expires between the Milford & Uxbridge Street Railway Company and the Milford Electric Light & Power Company, whereby the latter receives electricity from the former, the Milford Electric Light & Power Company will erect its own plant.

HAVERHILL, MASS.—The Haverhill Electric Company, in its latest proposition to the city, expresses itself as willing to undertake the build-

ing of a suitable system of conduits, to be completed within ten years, if the city will make a ten years' contract for arc lights at the present contract price of about $102 per light.

AYER, MASS.—The report of the committee which was appointed at the last town meeting to inquire as to the advisability of the town operating a municipal electric lighting plant, is in the hands of the printer and will appear in the annual reports. The present operators of the plant are the Block Electric Lighting Company of Boston.

STONEHAM, MASS.—Stoneham is becoming interested in municipal ownership, presumably because the service rendered by the corporation is unsatisfactory. At a recent town meeting a committee on municipal lighting was appointed consisting of the following: Arthur N. Newhall, Rev. J. H. Whitmore, Dr. Francis E. Park, Charles J. Emerson, James F. Monihan.

WEST NEWBURY, MASS.—The citizens of West Newbury are agitating the question of street lighting, and there is more or less interest in the scheme of uniting with Georgetown and Groveland in a system, which would probably mean electricity. Groveland has already worked in conjunction with the Georgetown committee in investigating the various systems of street lighting, and a report is expected within a short time.

WORCESTER, MASS.—The Worcester Light & Equipment Company, a new corporation to undertake to furnish light and power in Worcester under the old H. H. Bigelow franchise, has been formed with a capital stock of $100,000, and its certificate of organization has been filed at the State House. Albert M. Thompson is president; William J. Hall, treasurer; Winslow H. Robinson, clerk, and William E. Lewis, Elmer E. Carpenter, Paul Potter and Henry Schoenfeld, of New York, are directors.

CONSTANTINE, MICH.—H. von Schon, Detroit, is consulting engineer for a water power project on St. Joseph River, near this point.

MARINE CITY, MICH.—Application has been made by E. J. Ottaway and others to the Common Council of this city, for a franchise to do a general electric lighting and power business in this city.

BERRIEN SPRINGS, MICH.—F. A. Bryan, of South Bend, Ind., general manager of the Berrien Springs Water Power Company, writes that the proposed power plant to be constructed on St. Joseph River will cost about $500,000.

DETROIT, MICH.—The initial plan for the new street railway proposed by Mayor Codd contemplates the occupancy of about 51 miles of streets, including 1 mile of subway. There will be something like 90 miles of double track, or less than half of the mileage of the Detroit United Railways city lines. The promoters have figured the cost and financing as follows: One mile of subway, $1,000,000; surface lines, $3,000,000; power house $500,000; total cost, $4,500,000; bond issue, $5,000,000; underwritten at 90 per cent will net $4,500,000.

BLOOMING PRAIRIE, MINN.—The Steele County Telephone Company will make improvements to the extent of $4,000.

LEWISTON, MINN.—The Lewiston Telephone Exchange Company will increase its capital stock from $10,000 to $25,000.

FOREST CITY, MINN.—A. H. De Long has in contemplation the development of the water power of Crow Wing River for electrical purposes.

ST. PAUL, MINN.—The assembly has passed a resolution directing the St. Paul Gas Light Company to extend its electric service in the Fifth and Eleventh Wards.

ST. PAUL, MINN.—The Twin City Rapid Transit Company is considering a 15-mile extension from White Bear to Forest Lake, giving St. Paul a north suburban line 30 miles long.

VIRGINIA, MINN.—The Virginia Light & Water Company is a recent purchaser of an Allis-Chalmers-Reynolds Corliss engine for direct connection to an electric generator. The new unit is 22x36 inches and will supply power for lighting purposes.

SHAW, MISS.—The Sanders-Johnson Company, of Vicksburg, has secured the contract for the construction of water works and an electric light plant here, for $24,593.

REDCLOUD, NEB.—John Martz, construction engineer, of Seward, writes that bids will be received about May 15 for the construction of an electric light plant for Redcloud, to cost about $15,000.

FT. OMAHA, NEB.—Bids will be received until April 14 by Maj. M. Gray Zalinski, Q. M., U. S. A., for furnishing and installing electric fixtures in certain buildings, and for extending the lighting system so as to make proper connections therewith at this post.

RYOLITE, NEV.—F. L. Dwight, of South Bullfrog, says that plans for an electric railway are in contemplation in that district.

CANAAN, N. H.—G. H. Gordon, town clerk, writes that the construction of a municipal electric light plant is in contemplation, but nothing definite has been done.

DOVER, N. H.—The Luddy-Currier Company is making extensive additions to its manufacturing plant, and will also install new and additional power equipment.

CAMDEN, N. J.—The City Council, by a vote of 16 to 6, has adopted a report of the Street Committee recommending the preparation of a bill for passage by the Legislature providing for the issuance of $300,000 bonds to enable the city to lay underground conduits.

NEWARK, N. J.—The Board of Trade has declared in favor of Newark establishing a municipal plant for the lighting of the streets and public buildings, and recommended to the Mayor and Common Council the employment of experts to decide as to the best means to be adopted in carrying out the project.

MORRISTOWN, N. J.—At the March meeting of the Morris County Board of Freeholders, Frederick H. Alleman, secretary of the Morris County Traction Company, presented petitions representing over 50 per cent of the property owners on two proposed lines of single-track electric roads, and asked permission to build and run the trolley lines upon them. The first line is 3 miles long and runs through Rockaway Township to Denville and Mt. Tabor to the south side of Tabor Hill. The second line is 5 miles long, running on the county road from Mine Hill through Kenvil, Succasunna, Ledgewood, Hoptacong and Port Morris to Netcong.

PHELPS, N. Y.—The citizens have voted, March 20, to raise $2,200 per year for a period of five years for electric street lighting.

LAKE PLACID, N. Y.—The State Gas Commission has granted this village permission to construct and operate an electric light plant.

SYRACUSE, N. Y.—The Independent Telephone Company is planning extensive improvements the present season, which include 15 miles of subway construction.

WATERTOWN, N. Y.—The Board of Public Works is considering the advisability of establishing a municipal plant. Attorney V. K. Kellogg states that he is in position to procure estimates for the installation of a municipal plant and the cost of operating.

NEW YORK, N. Y.—Bids will be received until April 2 by C. B. J. Snyder, superintendent school buildings, New York City, for installing electric equipment in the Stuyvesant High School, Borough of Manhattan, and for installing electric equipment in School No. 92, Borough of Brooklyn.

WATERTOWN, N. Y.—The Committee on Lighting has recommended to the Board of Public Works that the bid of the Watertown Electric Light Company for lighting the city for 5 years be accepted at $75 per light per year. If the contract is ratified by the Council, the company will be asked to make extensive improvements to its system.

RIVERHEAD, N. Y.—The Fisher's Island Railroad Company, recently incorporated, has been granted a franchise by the town of Southold. The company is capitalized at $12,000, and the directors are Walter Ferguson, Alfred L. Ferguson, John F. Dempsey, Frank E. Hine, R. C. Shanklin, Charles W. Gordon, Alfred W. Duter, Walter Ferguson, Jr., and Alfred E. Bullock.

BUFFALO, N. Y.—Work has begun on the wrecking of twenty cottages at the Front, where the new power house is to be built by the Cataract Power Company. On the site of these houses a power house is to be built which will be a receiving station for electricity manufactured by the Canadian companies. The current will be brought across the river by aluminum cables.

EAST AURORA, N. Y.—D. N. Rumsey, for the Buffalo & Southern Railroad Company, states that the company has secured rights of way along the whole route and the road will be completed by August 1. The route of the new road will be from the terminal of the Buffalo, Gardenville & Ebenezer Railroad through the towns of West Seneca, Ebenezer, Elma, entering this village on Maple Street. Work will be begun early in the spring.

MINEOLA, N. Y.—As soon as the weather will permit, the extension of the electric railway from Queens to Mineola will be built. It will be part of the Long Island traction system, bought jointly by the Long Island Railroad and the Belmont interests, and the third-rail system, it is stated, will be extended as far east as Mineola and Hempstead, and the work of double-tracking the North Shore Division from Flushing to Port Washington will be begun.

JAMESTOWN, N. Y.—Electric street lamps cost this city $1.78 each for each month last year, according to the annual report of the superintendent of the municipal lighting plant, which was made public recently. Nearly 400 street lamps of 1200 cp each are in use. The above price was obtained by subtracting from the entire expenses of operation, together with interest on the investment of $107,000 for the plant, and a charge of 7 per cent of that amount as depreciation, the amount paid to the city for commercial lights.

ASTORIA, N. Y.—The Allis-Chalmers heavy-duty cross-compound engine, 16 inches and 32 inches, which was recently purchased by the Astoria Light, Heat & Power Company, New York City, will be installed at the Lawrence Point Station. The new unit which is of 500 hp, will be placed in the same station with two Allis-Chalmers horizontal cross-compound engines, 23 inches and 46 inches by 48 inches, which were formerly in service at the Goldsmith Station of the Brooklyn Edison Company and which were recently replaced there by a 5000-kw Allis-Chalmers turbine-alternator unit.

BUFFALO, N. Y.—William F. Sheehan, of New York, is said to have organized a company capitalized at $10,000,000, which will establish an electric railway between Buffalo and Erie, Pa. Properties purchased and amalgamated by the new company are the street railway lines of Erie, the Jamestown & Chautauqua Lake Railway Company, the Chautauqua Lake Steamship Company, the Buffalo, Dunkirk & Western Company, the Dunkirk & Fredonia Railway Company and the Hamburg Railway Company. Among the interests represented are said to be the Widener-Elkins syndicate, Bertram, Storrs & Griscom, the Dolan interests of Philadelphia, and the Ryan-Belmont interests of New York.

NEW YORK, N. Y.—It is announced that the high-speed electric railway between Newark and the down town part of New York, which was projected some time ago, is to be built by the McAdoo tunnels companies in connection with the Pennsylvania Railroad Company. The road is de-

signed to give a 15-minute connection between Newark and the City Hall, New York. It will be built by the McAdoo interests over the Pennsylvania's right of way, and there will be connection with the Pennsylvania at Harrison Street, Newark. There will be a 22-story terminal at Church and Fulton Streets, New York, and while there will be no connection for trains between the McAdoo tunnel and the Interborough lines, there will be a subway for passengers connecting the McAdoo terminal with the Interborough station at Fulton Street. The Newark line is to cost $6,000,000.

CHARLOTTE, N. C.—It is rumored that the Southern Power Company has absorbed the Whitney Reduction & Power Company.

ELM CITY, N. C.—The contract for a $10,000 municipal lighting plant has been awarded to the Electric Construction Company, of Richmond, Va.

DURHAM, N. C.—The Durham Traction Company is preparing to install a large steam turbine and motor-generator to operate its power and ice plants at Durham.

ROCKINGHAM, N. C.—Thomas F. Baxter, of the firm of Bond & Good, bankers, Boston, Mass., recently visited the water power development of the Bluitt Falls near this city. Mr. Baxter stated that the development of the power would be inaugurated within a few months.

MARION, N. C.—J. L. Morgan, director of the Marion Light & Power Company, writes that bids will be received at once for work in connection with the developing of the water power on Catawba River, which will cost from $8,000 to $10,000. Engineer, W. W. Latspeich, of Marion.

HICKORY, N. C.—Col. M. E. Thornton, of the Thornton Electric Light & Power Company, of this city, has secured possession of a valuable water power near here, where a plant will be constructed and electric energy transmitted to Hickory for the operation of the lighting and trolley systems.

MINOT, N. D.—The Minot Light & Telephone Company has increased its capital from $50,000 to $100,000.

ELLENDALE, N. D.—N. C. Peek, secretary of the Ellendale Light & Power Company, writes that it is proposed to construct an electric light plant there, at a cost of about $12,000. Engineers, Claussen, Burch & Pillsbury, of St. Paul, Minn.

YORKSHIRE, OHIO.—The Yorkshire Telephone Co., of Darke County, has increased its capital from $10,000 to $20,000.

CLEVELAND, OHIO.—The Washington Traction Company, a Springfield corporation, financed in this city, has increased its capital stock from $10,000 to $800,000.

PAINESVILLE, OHIO.—The Commercial Electric Company has been sold to J. R. Curtiss, trustee, of Geneva. It will ask for a franchise to furnish lights for the city.

DAYTON, OHIO.—The Globe Iron Works have been awarded the contract for furnishing the South Bend, Ind., water works and lighting plant with three turbine wheels, with all power connections.

MEDINA, OHIO.—F. O. Phillips, who has acquired the plant of the Medina Electric Light & Power Company, is preparing to overhaul the machinery and will add another boiler and other equipment.

COLUMBUS, OHIO.—Work has been commenced on the new $30,000 power plant to be used by the Columbia Electric Street Railway, Light & Power Company. The building will be erected at the foot of Pine Street.

WEST UNITY, OHIO.—The West Unity Power & Light Company, with a capital stock of $15,000, has been incorporated by James H. Miller, John A. Hollinger, Leon P. Charpoit, L. B. Kent, Lloyd L. Mann and others.

MASSILLON, OHIO.—Prominent citizens of Massillon have requested the Council to call an election with a view to issuing bonds for the erection of a municipal lighting station and the purchase of the water works plant.

LIMA, OHIO.—The Western Ohio Railway Company has arranged to light the villages of Rawson and Mount Cory. The company is going after residence and business lighting as well as power loads in a number of towns along its route.

ALLIANCE, OHIO.—The bid of the Alliance, Akron & Cleveland Electric Railway Company for a franchise to establish a route over certain portions of West Main Street was submitted to the Council and referred to the committee on railways and telegraphs.

CANTON, OHIO.—John E. Monnott, of Canton, promoter of the Canton & Youngstown Railway, claims that the financing of the road has been arranged for with eastern capitalists. The road will run from Youngstown to Canton by way of Mogadore, Atwater and Canfield.

WOOSTER, OHIO.—The Wooster Electric Light Company is going after farmers' business and is building a number of lines to points a considerable distance from the city. It is also building a line to the county infirmary, with several farmers' lines branching from it.

CLEVELAND, OHIO.—The Cleveland Light & Power Company is a recent purchaser of Allis-Chalmers Electrical Machinery, to be built at Cincinnati, consisting of a 200-kw, type H. I. generator, operated in connection with the present equipment for lighting and power purposes.

SALEM, OHIO.—The Salem Lighting & Power Company has taken an option on the lighting plants at Lisbon and Leetonia. A merger is proposed, including the erection of a large central lighting plant here, which will supply Salem, Lisbon and Leetonia, as well as farmers along the line.

BOWLING GREEN, OHIO.—The Toledo, Bowling Green & Southern Traction Company is buying right of way with which to rebuild portions of its line between Bowling Green and Findlay, cutting out a number of right-angle curves which now interfere with high speed. The company is planning for the through Dayton to Toledo limited service, which will probably be instituted early this summer.

CLEVELAND, OHIO.—Mayor Tom L. Johnson is endeavoring to get through the Council a measure providing for an appropriation of $40,000 for the purpose of enlarging the South Brooklyn lighting plant now owned by the city, by the installation of a 500-kw unit boiler and other needed accessories.

LEETONIA, OHIO.—Plans are being prepared by engineers of the Cleveland Construction Company, of Cleveland, for a large power station for the Youngstown & Ohio River Railway. The plant is to be located near Teegarden, Columbiana County, at which point the company has secured a large coal mine. (See Youngstown item below.)

CINCINNATI, OHIO.—Petitions signed by about 200 business men of Cincinnati and letters from merchants in some 40 towns urging the establishment of an independent telephone service in this city have been submitted to the Council Committee on Telephone by Attorney C. B. Matthews, of the Queen City Home Telephone Company.

NEWARK, OHIO.—Edward Kibler, one of the promotors of the Newark, Martinsburg & Mt. Vernon Railway, states that the company has now secured all the necessary franchises and that the work of constructing the road will start as soon as the weather permits. It is stated that Crosby & Company, of New York, will finance the road.

CANTON, OHIO.—The Arctic Ice Machine Company, of Canton, Ohio, has secured a $150,000 contract for a 200-ton ice-producing plant and an electrical plant for the Central Ice Company, Kansas City, Mo. It is also building a 40-ton ice plant for the Crystal Springs Ice Company, Cleveland. Electrical equipment will also be installed in the latter plant.

MASSILLON, OHIO.—The Massillon Light, Heat & Power Company has submitted a proposition for lighting the streets by electricity. The bid was as follows: 160 lamps for two years, $80 per lamp per year; five years $75, ten years $70; 180 lamps for two years $80 per lamp per year, five years $75, ten years $69.50; 50-cp. incandescent lamps $12 per year.

DAYTON, OHIO.—The Dayton Lighting Company, which is completing extensive improvements to its plant, has announced to the City Council that it will supply conduits for the city fire and police service free of charge, that the rate to the city in the future will not exceed 4 cents per kw-hour, and that beginning April 1, 1906, rates to consumers will range from 5.6 cents to 12 cents per kw-hour, with a discount of 10 per cent if paid before the 5th day of each month and that after April 1, 1907, the highest rate will be 10 cents per kw-hour, with the same rule as to discounts.

YOUNGSTOWN, OHIO.—The Youngstown & Ohio River Railway Company, which is being projected by Will Christy, J. R. Nutt, George Stanley, Max Goodman, Warren Bicknell and other well-known Cleveland people, will have a capitalization of $2,500,000 of common stock and $2,500,000 5 per cent twenty-year gold bonds. Of the stock, $1,700,000 will be issued immediately, while the bonds to be issued will be $1,500,000. It is thought it will cost about $1,500,000 to build the road, which will have a mileage of 56 miles. The main line will extend from Youngstown to East Liverpool, Ohio, and there will be a branch line from Washingtonville to Salem and one from Leetonia to Columbiana.

PORTLAND, ORE.—The city engineer has been instructed to prepare plans and specifications for a system of underground conduits.

AURORA, ORE.—The City Council has appointed a committee to confer with the Aurora Electric Company, and get prices for installing a system of electric lights.

SEASIDE, ORE.—A franchise has been granted to Rhodes & Welch to put in an electric power plant to furnish light to the city. They agree to turn on light in sixty days.

MILTON, ORE.—The City Council has taken steps to purchase the new machinery for the electric light plant. It will be a three-phase system with up-to-date machinery capable of generating 200 hp.

ASTORIA, ORE.—The Astoria Improvement Company has purchased the franchise recently granted W. W. Whipple, and will commence at once the construction of a gas and electric light plant and telephone system.

BAKER CITY, ORE.—J. K. Romig, of Baker City, secretary and manager of the Eagle River Electric Power Company, writes that the company will do its own construction work on the proposed hydro-electric power plant, the probable cost of which is estimated at $150,000.

PORTLAND, ORE.—The Portland Railway Company has decided on new construction work and extensions for this year to cost $200,000 and an appropriation of that amount has been made to cover the expenditures planned. Upwards of $50,000 will be spent for new buildings, and the remainder will go into projected extensions and double-tracking.

EUGENE, ORE.—F. L. Chambers, president of the Chambers Banking Company, of Eugene; A. B. Wood, manager of the Oregon & Southeastern Railway and of the Oregon Securities Company; G. B. Hengen, of the Oregon & Southeastern Railway, and O. F. Paxton, of Portland, have applied to the City Council for a franchise to construct an electric railway system in Eugene.

PORTLAND, ORE.—The Portland General Electric Company will construct a new power plant in Oregon City at a cost of $2,000,000. The capacity will be 49,000 hp. The company has purchased the Citizens' Light & Traction Company, of Salem, and the Union Light & Power Company, of Silverton from Barstow & Chambers, and will construct a line and furnish light and power to all towns between Portland and Salem.

OREGON CITY, ORE.—The Oregon City & Farmers' Independent Telephone Company is installing its local exchange at Huntley Brothers Company's drug store, in this city, and instruments are being very generally subscribed for by the merchants and business men of the city. This system will be in complete operation within a few days and will place Oregon City people in communication with more than 500 rural subscribers throughout the southern and eastern parts of the county. Other rural lines in other parts of the county are being perfected, and when these have been connected with the system a practically complete network of telephones will be in operation throughout the county, with a subscription list approximating 1000.

PAOLI, PA.—The Paoli, Wayne & Overbrook Street Railway Company will apply for a charter on April 16.

SCRANTON, PA.—The Economy Light, Heat & Power Company has decided to construct a power plant on Dix Court.

LEBANON, PA.—The County Commissioners are considering the construction of an electric light plant to light the county buildings.

NANTICOKE, PA.—The Nanticoke Power Company has purchased the Susquehanna dam and will construct a water power plant at that point.

WILKESBARRE, PA.—The Mayor has signed the ordinance permitting the Wilkesbarre & Hazleton Electric Railway to enter this city and erect a large station.

HAZLETON, PA.—Superintendent Giles, of the Hazleton Electric Light & Power Company, is making extensive improvements to the company's property all over the city.

HUMMELSTOWN, PA.—Allen K. Walton, of Hummelstown, has purchased the water and electric light plant, and will make improvements, including the installation of larger dynamos.

YORK, PA.—Bills granting to the York Telephone Company and the Pennsylvania Company the right to construct and maintain conduits in this city have been vetoed by Mayor James St. Clair McCall.

ALTOONA, PA.—The Altoona, Hollidaysburg & Bedford Springs Railway Company is reported to have authorized an issue of $1,200,000 bonds. The road is projected to run from Altoona via Hollidaysburg to Bedford Springs, a distance of 40 miles.

HARRISBURG, PA.—The Central Pennsylvania Traction Company expects to extend its line from Rockville to Dauphin during the present year over the abandoned towpath of the old Pennsylvania Canal, now owned by the Pennsylvania Railroad Company.

SHARPSVILLE, PA.—The Youngstown Sheet & Tube Company is a recent purchaser of Allis-Chalmers electrical machinery to be built at that company's works in Cincinnati, and consisting of a 75 kw engine-type generator. The new outfit will be used for incandescent lighting and power purposes.

DANVILLE, PA.—Bids will be received until April 10 by the Board of Trustees of the State Hospital for the Insane (Dr. Levi I. Shoemaker, chairman, care Dr. H. B. Meredith, superintendent), at Danville, for the erection of a power house, electric generator plant, engines, boilers, motors, etc., and the wiring of the administration building,, wards and other buildings, grounds, etc.

KINGSTREE, S. C.—The citizens have voted to issue $12,000 bonds for an electric light plant.

GIDDINGS, TEX.—Pfeil Bros. are preparing to install an electric plant at this place, and have their power house under construction.

GONZALES, TEX.—Mr. J. M. Murphy, of the Gonzales Telephone Company, is making arrangements to extend the teritorial lines to the new town sites in this country along the Gulf Shore Railroad.

PALESTINE, TEX.—The Palestine Electric Light Company has applied for a new franchise, covering a period of fifty years, giving it the right to generate electricity for power, heat and light for the city of Palestine.

DECATUR, TEX.—A movement is on foot to establish a rural telephone exchange in Decatur, one that will give connection with all the other towns in the county that have telephone lines, and put every farmer who has a telephone in full connection with the whole county.

BRACKETT, TEX.—A new long distance telephone system is being put over this part of Texas with Spofford of this county as the central point. The lines have been staked from Spofford to Del Rio, Brackett, Eagle Pass, Uvalde and other places. About four months ago the Lone Star Telephone system covered most of the same ground and when the new one is complete there will be two complete lines. The new system is the Southwestern Telephone Company.

SHERMAN, TEX.—The North Texas Telephone Company recently organized here for the purpose of constructing and operating an independent telephone line from Sherman to Gainsville is now weaving a web of wires all over Grayson and Cooke counties. The capitalization of the company at the time of organization was $10,000. This was doubled a few months ago. and now the company is again considering doubling the capitalization, making it $40,000. The company has purchased the exchange at Whitesboro, formerly owned by a local company, and toll line connections out of Whitesboro have been acquired. These lines connect with McComb, Ethel, Day, Sadler, Gordonville, Basin Springs, Red Branch and Dexter.

SALT LAKE CITY, UTAH.—W. P. Read and John Montgomery, of the Utah Light & Power Company, of Salt Lake City, are planning to extend their lines to Sandy, to furnish light and power to the residents and plants of that town.

OGDEN, UTAH.—The Utah Light & Railway Company has just acquired 160 acres of land at the head of Ogden Canyon, for a new reservoir, which, when completed, will cover about 2,500 acres. The water conserved will be used to irrigate arid lands in the Salt Lake Valley, in addition to furnishing electric power for all purposes, both in Ogden and other parts of Utah.

SALT LAKE CITY, UTAH.—J. J. Chambers, president of the Inter-Mountain Power Company of Salt Lake City, says that one-half million dollars will be spent this year by the company on improvements. A dam will be built, 600 feet long and 85 feet high, forming a reservoir. A water wheel and generator will be put in at the dam. Contracts will be awarded during the next thirty days for 6,000-kw of electrical equipment and for 2,500 feet of wood and steel pipe.

EMPORIA, VA.—The Greensville Water Power Company will soon construct a 36-foot dam and install machinery to develop about 4000 hp, on Meherrin River, at Emporia.

BURLINGTON, VT.—The contract to extend the Burlington electric light plant has been awarded by the Electric Light Commissioners to the Westinghouse Machine Company, of Pittsburg, Pa., for $14,488.

ST. ALBANS, VT.—The Vermont Power & Manufacturing Company will make notable improvements in the plant and transmission line this spring. A duplicate transmission line from the power house to this city will be strung on the same poles, and new step-up and step-down transformers will be placed at either end of the line.

OLYMPIA. WASH.—The City Council has granted John L. Murray and associates a franchise for an electric light plant.

PRESCOTT, WASH.—Roberts & Henderson, of Waitsburg, have secured a franchise for an electric light plant in Prescott.

NORTH YAKIMA, WASH.—Ira P. Englehart has filed a petition for 3,000 cu. in. of water per second from Naches River, to be used for power and manufacturing purposes.

VANCOUVER, WASH.—The Skamania Co-operative Telephone Association has applied to the County Commissioners for a franchise to build a telephone line from Washougal to connect with the Association's line in Skamania County.

SPOKANE, WASH.—The Washington Water Power Company is planning to bury all its high-voltage lines in this city, although it will probably be a year or more before the conduits are actually installed. Delivery of poles and insulators has commenced for the extension of the line to Colfax and Palouse, which should be ready for service by July 1.

HUNTINGTON, WASH.—The town board has granted C. C. Johnson and W. Howard a franchise to supply the town with electric lights. It is the intention to put in a water power plant up the canyon to generate electric power for lighting system and to run a flour mill soon to be erected.

SEATTLE, WASH.—At the recent city election William Hickman Moore known as the municipal ownership candidate, was elected by a plurality of 15 votes. As a result of the election the city will probably proceed with the contemplated increase of the Cedar River municipal power plant that is now furnishing power for the city lighting.

PULLMAN, WASH.—An ordinance has been passed providing that the city lighting plant be leased to the Moscow Electric Light & Power Company, of Moscow, Ida., which proposes to reconstruct the entire lighting system of the city. The contract has been signed for a term of years, and the company will at once proceed to make the improvements.

SPOKANE, WASH.—George Donald, president of the Yakima National Bank, of North Yakima, Wash., announces that he and his associates will build a $200,000 hydro-electric plant to enter into competition with the Northwestern Light & Power Company, doing business in North Yakima, the latter owned by Robert E. Strahorn of Spokane. Power will be secured from the Nachez River.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company has mortgaged its plant, franchise, equipment, etc., for $2,500,000 to the City Trust Co., of Boston. Of the amount realized $500,000 will be used for completing the hydro-electric power plant at Noksack Falls, $1,400,000 will be used to pay off an old mortgage, and the remaining $600,000 will be used as required in future improvements.

SEATTLE, WASH.—The Bates & Clark Company, of Seattle, Wash., successor to the Bogart-Bates Company, engineers on the Pacific Coast, recently contracted with the Allis-Chalmers Company through its Seattle office for a lot of electrical machinery to be built at its Cincinnati works. The new outfit will consist of a 250-kw water-wheel-type alternator, 60 cycle, three phase and 2,300 volts; also a small 6-kw exciter and switchboard.

SPOKANE, WASH.—The Lewiston-Clarkston Company is employing 125 men laying its new pipe line from Asotin Creek to Vineland for its new hydro-electric plant. This new line will give the company 200 feet greater fall than it had from the old ditch. Wood pipe is used for the gravity line. This company plans the development of 6,000 hp at the Grand Round River, thirty miles south of Lewiston. E. A. Libby, president of this company, is quoted as saying that there will be an electric railway between Lewiston and Clarkston in the near future.

SPOKANE, WASH.—Jay P. Graves, president of the Spokane Traction Company, who recently purchased the Kuttle Fall water power, has also purchased the "Bowl and Pitcher" power site, seven miles down the Spokane River, paying $50,000 for it. The purchase includes the franchises in Spokane, which was granted to the Spokane Light & Power Company

March 31, 1903. It is understood Mr. Graves and associates will put in a light and power plant at a cost of $500,000, which will be a competitor for the Washington Water Power Company.

WHEELING, W. VA.—Bids will be received by Major George A. Zinn, Corps Engineers, U. S., until April 10, for furnishing engines, boilers, pumps, etc., for lock No. 4, Little Kanawha River, West Virginia.

MILWAUKEE, WIS.—The Altpeter property, on the Kinniekinnie River, between Walker and Washington Streets, has been selected as the site of a municipal electric lighting plant by the council committee on finance and public buildings.

MILWAUKEE, WIS.—The Mechanical Appliance Company of Milwaukee, has ordered for the White Star Laundry, of Cincinnati, Ohio, a number of Allis-Chalmers motors which are to be built at the company's works at Cincinnati. These machines will range in capacity from 7½ to 15 hp.

BRANDON, MAN.—The flour mill owned by Alexander & Law was destroyed by fire, including all the electrical machinery.

TORREON, MEX.—It is said that over $150,000 has been subscribed by the leading business men of Torreon for the formation of a new company which proposes to erect in that city one of the most complete electric plants to be found in northern Mexico. According to the plans, which were made some time ago, all of the machinery to be installed in the new plant will come directly from the United States.

HALIFAX, N. S.—A special committee is considering the advisability of this city installing a municipal electric light plant. It is proposed to petition the Legislature for permission for the city to do commercial lighting, power and heating, and if same is not secured to purchase franchise of the Halifax Electric Tramway Company.

HAILEYBURY, ONT.—The Haileybury & Cobalt Telephone Company has increased its capital stock from $5,000 to $40,000 for the purpose of extending its system.

MEAFORD, ONT.—The citizens have voted to guarantee a loan to the Georgian Bay Milling & Power Company, to aid it in further developing the power dam at this place.

EUGENIA, ONT.—Bids will probably be received in May for the construction of a power plant here for the Georgian Bay Power Company. Engineer, H. von Schon, of Detroit.

MORRISBURG, ONT.—The Village Council has awarded to William Birmingham, of Ottawa, the contract for constructing a 1,100-hp electric plant on St. Lawrence River Canal, around Duplatte Rapids, for $73,600.

PORT BURWELL, ONT.—The Erie, London & Tilsonburgh Electric Railroad is applying for permission to build a line from here to London, passing along the shores of Lake Erie. The length of the line will be about 35 miles.

TORONTO, ONT.—Mackenzie & Mann, railroad contractors, have secured control of the stock of the Niagara, St. Catherines & Toronto Electric Railway Company and will build a number of extensions. The company now operates 37 miles of tracks.

PANAMA.—Bids will be received until April 13 at the office of D. W. Ross, general purchasing officer, Isthmian Canal Comn., for furnishing sheet steel and iron rivets, pipe fittings, valves, portable forges, water meters, tubular boilers, marine boilers, equipment for electric light plant, duplex pumps, feed-water heaters, condensers, steel stack, etc.

REGINA, SASK.—J. H. Haslam, of the Haslam Land Company, St. Paul, Minn., is negotiating for the building of an electric street railway in this city.

Company Elections.

ANDERSON, CAL.—The Happy Valley Telephone Company, which was organized recently at Olinda, has elected the following officers: President, M. A. Batson; vice-president, S. Hilton; secretary, L. D. Walker; treasurer, A. L. Walker; trustees, M. P. Buffum, J. H. Walker and G. H. Nutting.

SAN FRANCISCO, CAL.—At a recent meeting in this city of the Northern Electric Company, which is building a new electric railway between Chico and Oroville Henry A. Butters was elected president. The board of directors includes J. Downey Harvey, Louis Sloss and E. R. Lilienthal, and the company, organized a year ago, is capitalized at $6,000,000.

KALAMAZOO, MICH.—At the annual meeting of the stockholders of the Grand Rapids & Kalamazoo Valley Traction Company the following directors were elected: E. J. Anderson, E. J. Henry, C. B. Kelsey, George Hefferan and W. H. Patterson. The officers of the board were elected as follows: W. H. Patterson, president; E. J. Anderson, secretary; C. B. Kelsey, treasurer. The directors announce that the construction work will be pushed rapidly when the weather will permit. It is stated that the line will be built only to Otsego this year, but cars will be running between Kalamazoo and that place by July.

PICKWICK, MINN.—The Pickwick-New Hartford Telephone Company held its annual meeting recently and elected officers for the ensuing year. John Leeps was elected president; Ed. Jusmann, vice-president; George Davis, secretary, and J. M. Rutherford, treasurer.

ROCHESTER, N. Y.—The officers of the Rochester Railway Company, elected at its recent meeting, are: Horace E. Andrews, president; John J. Stanley and William M. Eaton, vice-presidents; W. M. Eaton, treasurer; J. C. Collins, secretary and assistant treasurer; R. E. Danforth, general manager; directors, Horace E. Andrews, of Cleveland; W. K. Vanderbilt, Jr., E. V. W. Rossiter, John Carstensen, W. J. Wilgus, W. C. Brown, A. G. Hodenpyl and Albert H. Harris, of New York; W. M. Eaton, Charles J. Bissell, George W. Archer, Charles T. Chapin and George F. Roth, of Rochester. The officers of the Rochester & Suburban Railway are: Horace E. Andrews, president; W. M. Eaton, vice-president; J. C. Collins, secretary and treasurer; directors, W. K. Vanderbilt, Jr., E. V. W. Rossiter, John Carstensen, W. J. Wilgus, W. C. Brown, G. W. Archer and C. T. Chapin. The officers of the Rochester & Sodus Bay Railway Company are: Horace E. Andrews, president; Granger A. Hollister, vice-president; J. C. Collins, secretary and treasurer; directors, Horace E. Andrews, W. K. Vanderbilt, Jr., E. V. W. Rossiter, John Carstensen, W. J. Wilgus, W. C. Brown, G. A. Hollister, W. M. Eaton and Benjamin Strong.

New Industrial Companies.

THE BEE ELECTRICAL COMPANY, New York, N. Y., has filed articles of incorporation, with the following directors: A. M. Bullowa, E. E. M. Bullowa and E. M. Bullowa. The company's capital is $500.

THE GALT ELECTRIC GAS FIXTURE COMPANY has been incorporated at Galt, Ont., with a capital of $40,000, to manufacture electric and gas fixtures. The directors include H. Dakin, R. G. Struthers and M. A. Secord, Galt, Ont.

THE LUMEX ANTI-VIBRATING SYSTEM, Millbrook, N. Y., has been incorporated by Harry Harris, J. J. Barber and S. F. Fromm. The company has a capital of $200,000 and will manufacture motors and other machinery.

THE APEX MOTOR COMPANY, Bergen, N. Y., has been incorporated with a capital of $15,000, and will engage in the manufacture of engines, motors, automobiles, etc. A. A. Sands, G. E. Parish, and F. O. Bullis are the incorporators.

THE F. H. AYER MANUFACTURING COMPANY is being organized at Chicago Heights, Ill., with a capital stock of $10,000, to manufacture and deal in electrical supplies. The incorporators are William E. Canedy, Fred H. Ayer and Vanness D. Smith.

AUTOMATIC FIRE SIGNAL TELEGRAPH COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital of $100,000. The directors are named as follows: A. M. Friedenburg, H. H. Kutner and A. L. Lowenstein, of New York.

New Incorporations.

GADSDEN, ALA.—The Gadsden Railway, Light & Power Company has been incorporated by G. H. Schuler, E. T. Schuler and O. R. Reed. The Schulers are owners of big mill and steel-making plants.

SAN LUIS OBISPO, CAL.—The Paso Robles Light & Water Company has been incorporated by J. A. Watt, M. R. Van Wormer, A. W. Copp, W. C. Henderson and W. S. Stanley.

REDDING, CAL.—The Latonia Telephone Company has been organized with officers as follows: J. R. Spann, president; J. H. Forbes, vice-president; Charles Kooser, secretary; H. G. Smith, treasurer.

SAN FRANCISCO, CAL.—The Citizens' Mutual Light, Heat & Power Company has been incorporated with a capital stock of $500,000 by Phillip Meyer, Peter Harder, Alexander Mackie, G. H. Bahrs and F. Hausmann, with place of business, San Francisco.

SAN FRANCISCO, CAL.—The Pescadero Railway & Improvement Company has been incorporated with a capital of $600,000 to build a branch to the Ocean Shore Railway at Pescadero. The shareholders are L. H. Sage, George Lieungh, R. J. Graham, W. L. Dean, J. H. Goldman, L. R. Notbohm and J. B. Rogers.

NAPA, CAL.—The Clear Lake & Southern Railroad Company has filed an application for a franchise to operate a railway on the streets of Napa. The company has a capital stock of $3,500,000 and the following five directors: K. J. C. Seymour, of Mill Valley, president; G. C. Calden, of Oakland, secretary; Joseph P. Lucey, W. E. Cashman and William T. Love, of San Francisco.

NAPA, CAL.—The Napa & Lockport Railroad Company has applied to the City Council for a franchise to construct and operate an electric railway in Napa. The new company is incorporated with a capital stock of $2,000,000. The directors include W. S. McConlick, of San Francisco, president; W. M. Doane, of San Francisco, secretary; R. M. Hotaling and W. M. Rank, of San Francisco; E. C. Amadee, A. S. Brown and F. W. Ansell, of Alameda County.

CHICAGO, ILL.—The Channakon Power Company, with a capital of $100,000, has been incorporated by Charles A. Munroe and others.

GRAND TOWER, ILL.—The Big Muddy & Grand Tower Telephone Company filed articles of incorporation March 20 with a capital stock of $600. The incorporators are M. W. Baysinger, C. D. Gardiner and James Hudson.

MOLINE, ILL.—It is announced that the $10,000,000 deal of public utilities of Moline and Rock Island, Ill., and Davenport, Ia., effected by an eastern syndicate headed by J. R. Beetem, of Philadelphia, has been completed. The new company will be known as the Tri-city Railway & Light Company and will embrace the public service corporations of the three cities. Mr. Beetem was at one time general manager of the New York & Queens County Railway Company, of Long Island City.

GOODLAND, KAN.—A charter is reported to have been granted to the Goodland Heat & Power Company, with a capital of $50,000 to construct an electric light plant.

DIXFIELD, ME.—The Dixfield Light & Water Company has been incorporated for the purpose of supplying electricity and gas for lighting, heating and power, and water for domestic, fire and other purposes, in the towns of Dixfield, Peru and Mexico, with $50,000 capital stock, of which $500 is paid in. Officers: President, John A. Decker, of Dixfield; treasurer, James P. Johnston, of Dixfield.

IRON MOUNTAIN, MICH.—The Iron Mountain Light & Power Company has been incorporated with a capital of $50,000.

DETROIT, MICH.—The Co-operative Construction Company has been incorporated in the State of Michigan with a capital stock of $10,000, the main purpose of the organization being the promotion and construction of an electric railway from Grand Rapids to Ludington via Fremont, Herperia, Hart and Pentwater. The officers of the company are George E. Hilton, president; John Pikart, vice-president; John C. Anderson, secretary, and Thomas David, treasurer, all of Fremont.

RUTHTON, MINN.—The Currant Lake Co-operative Telephone Company has been formed with $10,000 capital.

ELLSWORTH, MINN.—A new telephone company has been organized here, which will establish lines and exchanges in the villages of the county. The incorporators are J. E. Foley, A. Combacker, N. U. Buck, W. P. Knowles, F. A. Severance and J. T. Beddall.

ALINE, MO.—The Aline Farmers' Mutual Telephone Company, with a capital stock of $2,000, has been incorporated by H. C. Geist and others.

ATKINSON, NEB.—The Citizens' Telephone Company, of this city, has filed articles of incorporation with the Secretary of State, with capital of $5,000.

TRENTON, N. J.—The Trenton Light & Equipment Company, with a capital of $100,000, has been incorporated by Louis Wolfson, William Schlessinger and William Wolfson.

WILLOW POINT, N. Y.—The Willow Point Telephone Company, with a capital of $500. has been incorporated by F. A. Pierce and others.

STERLING, N. Y.—The Red Creek & Fair Haven Telephone Company, with a capital of $930, has been incorporated by William Bailey and others.

ALLEGANY, N. Y.—The Citizens' Telephone Company, of Allegany, N. Y., has been incorporated with a capital of $10,000. Incorporators: C. L. McGavern, C. S. McGavern, O. J. Lewis, Allegany.

NASSAU, N. Y.—The Rural Home Telephone Company has filed articles of incorporation, with a capital stock of $50,000, and the following board of directors: I. R. Coughtry, E. M. Woodward, P. J. Callan and R. I. Hopewood.

PENN, N. D.—Penn Rural Telephone Company, with a capital of $7,000, has been incorporated by George Durgman, and others.

ELLENDALE, N. D.—Ellendale Light & Power Company, with a capital of $25,000, has been incorporated by Thomas Sefton, and others.

WASHBURN, N. D.—The Washburn Telephone Company, with a capital of $25,000, has been incorporated by August E. Johnson, Washburn; Charles N. Hendrise, Thomas W. Allshouse, Steele.

CLEVELAND. OHIO.—The Everett-Moore syndicate has incorporated the Sandusky, Fremont & Southern Railway to build a branch line for the Lake Shore Electric Railway. Incorporators are: T. H. Hogsett, H. H. Hogsett, M. C. Aleaman, George H. Kelley, George C. Ford and H. H. Johnson, all attorneys for the syndicate. Temporary capital stock is $10,000, and this will probably be increased to $500,000. The road will extend either from Sandusky to Fremont or Sandusky to Clyde, the exact route having not been fully decided upon.

ENID, OKLA.—A territorial charter has been issued to the Enid Street Railway Company. The company has a capital stock of $200,000 and was incorporated by P. J. Goulding, H. H. Champlin, Frank Bradford, W. L. Spencer and J. M. White.

NEWKIRK, OKLA.—A charter was issued March 23 to the Newkirk Commercial Mutual Telephone Company. The capital stock is $12,000. The incorporators are C. A. Johnson, H. M. Zeigler, A. J. Green, J. F. Hufbear, G. L. Milam, W. S. Cline and A. C. Harrington, all of Newkirk.

ASTORIA, ORE.—Articles of incorporation of the Astoria & Coast Interurban Railway Company have been filed. The capital stock of the company is $300,000, and the incorporators are Charles M. Cartwright, William L. Dudley, Edgar J. Daly, Sanderson Reed, B. F. Allen and J. Frank Watson. The main office of the company is to be at Astoria and its object is to build and operate a railroad between Astoria and Seaside and to engage in the business of supplying individuals and municipal corporations with electric lights, water and gas.

PENDLETON, ORE.—The Umatilla County Mutual Telephone Company was organized in Pendleton, when 50 farmers met and perfected the organization of the company. The new line will have over 100 telephones and more than 350 miles of wire. The territory will reach from Heppner on the west to the Washington boundary, and will be enlarged as time passes. The central office will be in Pendleton. At the meeting W. Harrah was elected president; A. Rupke, vice-president; H. H. Gilbert, secretary and treasurer. It is the intention to extend the lines of the new company until practically every farm in Umatilla County is served.

WEST CHESTER, PA.—A charter has been granted to the West Chester Steam Heat & Power Company, with a capital of $5,000, by Marshall H. Matlock, James E. Pyle, and others.

NEW BEDFORD, PA.—The New Bedford Telephone Company, with a capital of $5,000, has been incorporated. Directors: S. M. Porter, J. A. Brown, E. K. Cover, Pulaski; W. S. Lowry, E. A. Tobey, New Bedford; W. W. Brownlee, Ellis Smith, Lowellsville, O.

PITTSBURG, PA.—J. D. Callery, president of the Pittsburg Railways Company, has announced that the Castle, Shannon & Bethel Street Railway Company, controlled by interests identified with the Pittsburg Company, is being formed for the completion of the 11-mile link between Pittsburg and Washington, and that it will connect with the Washington line at Canonsburg. It is expected that the construction of the line will cost $1,000,000. The incorporators of the company are C. W. Lepper, purchasing agent of the Philadelphia Company; E. J. Cochran, who is in charge of teams; Frank McCarthy, clerk of the superintendent, and W. J. Horgan and David J. Woods, employees of the Pittsburg Railways Company.

PROVIDENCE, R. I.—The Westerly & Connecticut Railway Company has been incorporated with a capital stock of not to exceed $400,000. The incorporators are William Segar, James M. Pendleton, R. W. Perkins, H. H. Gallup and E. W. Jackson, with an office in the town of Westerly, R. I.

PIERRE, S. D.—Articles of incorporation have been filed for the Farmers' & Merchants' Telephone Company at Verdon, with a capital of $10,000. Incorporators are J. C. Barwell, and others.

GALLATIN, TENN.—A charter has been granted at Frankfort, Ky., for the construction of an electric railway from Stanford, Lincoln County, Ky., to Gallatin. The capital stock is placed at $150,000, and the incorporators are W. G. Schamberger, of Gallatin; J. I. White, Dr. Peyton, Harvey Helms, Judge Bailey, and other business men of Stamford, Ky.

NORFOLK, VA.—The Consolidated Electric Company has been incorporated with a capital stock of $15,000, by C. W. Breedlove. The objects of the company are to "fit railroad, lighting and power plants and telephone lines with electricity," and also to establish a general supply business.

MILWAUKEE, WIS.—The Milwaukee Telephone & Manufacturing Company, with a capital of $25,000, has been incorporated by Edward M. Maxwell, and others.

ARCADIA, WIS.—The Tamarack Telephone Company has been organized at Arcadia, Trempealeau County, and incorporated with a capital stock of $30,000. The incorporators are Calvin Gilberston, Albert Svverson, Ole O. Olsen, Alexander Olsen and Thomas Thornson.

KIRKTON, ONT.—The St. Mary's, Kirkton & Exeter Telephone Company has been incorporated with a capital of $50,000 to carry on a general telephone business. The provisional directors include W. R. Carr, Kirkton; J. W. Graham, St. Mary's, and J. G. Jones, Exeter, Ont.

Obituary.

MR. GEORGE O. WHEATCROFT, assistant secretary and assistant treasurer of the Milwaukee Electric Railway & Light Company, died a few days ago at his home 321 Farwell Avenue, Milwaukee, Wis. Mr. Wheatcroft was one of the pioneer street railway men of Milwaukee, having been connected with the street railways since 1868. He was born in Derbyshire, England, June 14, 1851, and came to Milwaukee when he was 18 years of age, entering street railway service as a conductor.

PROF. R. O. DOREMUS.—It is with deep regret that we note the death of Prof. R. Ogden Doremus, in New York City, at the ripe age of 82. Member of old English and Dutch families of Manhattan Island, he graduated from New York University, and as early as 1848 had equipped a laboratory. He was one of the founders of the New York Medical College, the Long Island Hospital Medical College, and Bellevue Hospital Medical College, urging in each case the necessity of provision of a chemical laboratory, where the students could have thorough chemical training. From 1853 to 1861 he was Professor of Natural History at the Free Academy, now the College of the City of New York, and afterward was appointed to the Chair of Chemistry and Physics in the same institution. He made the laboratory at Twenty-third Street and Lexington Ave. a famous centre for study, particularly in connection with electricity. His museum there was filled to overflowing with early electrical apparatus and instruments of great historical and technical value as bearing upon the early development of electrical industry. On one occasion at the Academy of Music, in 1855, when lecturing, he took daguerreotypes of all the persons in the boxes by an arc light and exhibited an induction coil with a 6-inch spark, a marvelous achievement in those days. His pioneer achievements in sanitation, toxicology, chemistry, etc., were not less notable, and he was also a founder and president of the Philharmonic Society. Two of his sons, Prof. C. A. Doremus and Mr. A. L. Doremus, are well known respectively in the electrochemical and electrical manufacturing fields.

Personal.

MR. A. G. STARR, general manager of the Maryland Telephone Company, of Harford County, has resigned his position, to take effect April 1.

MR. C. L. EDGAR, president of the Boston Electric Light Company, has been bereaved during the past week by the death of his father, who had been ill for some time past, and who was buried this week at Rahway, N. J.

MR. JOHN S. ALLEN, formerly manager of the Beloit Electric Company up to the time of its consolidation with the gas and water companies, is now sales manager of the John Thompson Company, of Beloit, manufacturer of gas producers.

MR. L. LINDER, who was at one time connected with French Thomson-Houston interests and now represents the productions of Mr. S. Bergmann in the French market, is on a visit to this country from Paris, and will stay on this side about a month, renewing old friendships and visiting the chief points of electrical interest.

MR. S. H. PITKIN.—At the recent annual meeting of the Wellman-Seaver-Morgan Company, of Cleveland, O., the office of general manager, which has been vacant since the death last June of Mr. Charles H. Wellman, was filled by the election of Mr. S. H. Pitkin, whose present title will be first vice-president and general manager.

MR. W. K. PALMER, consulting engineer, 718 Dwight Building, Kansas City, Mo., has been engaged by the city of Holton, Kan., to serve as an engineer in connection with the preparation of plans and specifications, for and the superintendence of construction of, the complete municipal improvements contemplated by the city, including water works system, electric lighting plant and sewerage system, to cost in the aggregate $83,000.

MR. A. WILLIAMS, chief inspector, etc., of the New York Edison Company, has sustained a severe bereavement in the death of his father, the Rev. C. S. Williams, a well known Brooklyn clergyman, who for thirty years past has been a member of the Methodist Episcopal New York East Conference, and has filled a dozen pastorates in Brooklyn, as well as others, prior to that period, outside this district.

MR. R. H. REED, whose efforts as sales manager for the Reeves Engine Co., of Trenton, N. J., have given the engine a wide reputation during the past four years, is to sever that connection on March 31. His executive ability, knowledge of business and natural talents form a combination of exceptional strength at the organization and selling ends of an engine business—a combination that we hope will not be lost to this particular field.

MR. JOHN JOLLY, manager of the Frontier Telephone Company, Buffalo, N. Y., has accepted an offer from the Indestructible Fibre Company, of New York, to become its general manager. He will leave Buffalo for New York to assume his new duties about April 1. The company manufactures imitation woods for cars, automobiles and interiors, and has a large factory at Massena, N. Y. Mr. Jolly has been connected with the Frontier Company since May, 1902.

MR. J. L. ADAMS, for the past eight years superintendent of the Hartford, Manchester & Rockville Tramway Company, Hartford, Conn., has tendered his resignation to John K. Punderfoot, general manager of the Consolidated Railway Company. Mr. Adams has been offered the position of superintendent of the railway company operating lines in Columbus and Dayton, Ohio, which consist of about 150 miles of track. He will enter upon his new duties as soon as his resignation is accepted.

MR. F. NICHOLLS.—*The Busy Man's Magazine*, an excellent publication issued in Toronto, Canada, has in its March issue an illustrated biographical sketch of that well-known Canadian, Mr. Frederick Nicholls, vice-president of the Canadian General Electric Company, and formerly president of the National Electric Light Association. He is well described as "one of the most aggressive and epoch-making Canadians that ever came out of England." In addition to the electrical interests he has developed so successfully, Mr. Nicholls is now deeply interested in steel works, mines, railroads, newspapers, etc., and still has time to build and sail, for patriotic glory, international yachts in the competitions on the Great Lakes.

MR. D. H. WILSON, JR., has been appointed electrical engineer of the Erie Railroad, in charge of the power plants and other electrical equipment along the entire system. The Erie Railroad, in recognition of the increasing importance of the electrification work which is being pushed on sections of the system in New York State, has created the office of electrical engineer. Dr. David H. Wilson, the new appointee, comes to the road from the American Locomotive Company. He will devote himself at first to the work of equipping the Erie's big power house at Hornellsville. He has been trained in the shops as well as in the schools. After serving a four years' apprenticeship in the Rogers Locomotive Works at Paterson, N. J., he studied electrical engineering at the Bliss School in Washington, and then graduated from Purdue University. Before his connection with the American Locomotive Company, Mr. Wilson was on the staff of J. G. White & Co.

MR. J. W. LIEB, JR.—On Thursday evening, March 15, Mr. J. W. Lieb, Jr., third vice-president and associate general manager of the New York Edison Company, lectured before the members of the Electric Club, at Pittsburg, an organization composed of apprentices and engineers of the Westinghouse Companies, on the subject of "Generation and Distribution of Current for Lighting and Power on Manhattan Island." Mr. Lieb gave a statement of the growth of the apparatus and systems of his company from the earliest days, and presented in connection therewith some excellent illustrations by means of lantern slides. He cited various points in connection with the present operation, calling attention to the variety of service afforded the public. He also showed load curves which were characteristic for different sections of the city, and showed the variations in these curves at different seasons of the year. The lecture was well attended and highly appreciated.

KAFER, MATTICE & WARREN.—Three distinguished engineers have just formed a partnership under this title with offices at 60 Wall Street, where they will practice as consulting engineers. The firm includes Mr. John C. Kafer, past president of the Engineers' Club; Mr. A. M. Mattice and Mr. B. H. Warren, both well known in the electrical field from their recent prominent connection with Westinghouse and Allis-Chalmers interests. The scope of the work of the firm includes specifications, estimates and plans for steam, hydraulic, gas and electric power plants, also for mills, industrial establishments, water works and mining plants; improvement of existing plants; examination and valuation of and advice concerning industrial properties, steamships and yachts; specifications and plans for marine machinery; advice as to scope and value of inventions; supervision of construction and operation of plants; acting as agents for estates and capitalists in the purchase and operation of power and manufacturing properties, and engineering work in general.

MR. GEORGE HERBERT ROWE has become associated with W. Owen Thomas, consulting engineer, First National Bank Building, Chicago. Mr. Rowe is a graduate of the University of Michigan, class of 1891. From 1891 to 1893 he was an instructor in electrical engineering at that university, leaving there to take the chair of physics in Colorado University. From 1900 to 1901 he was on the staff of designing engineers of the General Electric Company. From 1903 to 1905 he was professor of electrical engineering at Leland Stanford University in California, leaving there to become designing engineer with the Western Electric Company at Chicago in 1905, which position he has just left to become associated with Mr. Thomas. He is well known through his contributions to technical literature, most notable among which are his papers on wave form variations of long-distance lines, presented to the A. I. E. E., alternating-current laboratory testing, in the *Journal of Electricity*, and a new harmonic analyzer, described in the ELECTRICAL WORLD. He has made a translation of Heyland's circle diagram papers jointly with Mr. R. E. Hellmund which is about to be published. He is a member of the A. I. E. E. and the Society for the Promotion of Engineering Education. By virtue of his intimate acquaintance with technical matters pertaining to machine design, he is a most valuable acquistion to Mr. Thomas' staff.

Trade Publications.

RAILWAY MOTORS.—The General Electric Company, Schenectady, N. Y., has issued supply catalogue No. 7595 dealing with repair parts of G. E.-61-A and B railway motors.

DIRECT-CURRENT MOTORS AND GENERATORS.—The Allis-Chalmers Company, Cincinnati, Ohio, has issued instruction book No. 5003, dealing with the installation and operation of direct-current motors and generators.

FREQUENCY CHANGERS.—The National Electric Company, Milwaukee, Wis., is sending to its friends a neat half-tone illustration showing a 1,000-kw frequency changer. This is one of a recent order for four of these machines received by the company.

REINFORCED CONCRETE.—The Trussed Concrete Steel Company, Detroit, Mich., has issued an interesting and instructive catalogue dealing with Kahn trussed bars. The catalogue is a treatise on reinforced concrete and contains records of numerous tests made upon trussed bars.

WATT-HOUR METERS.—Bulletin No. 4,432 of the General Electric Company, Schenectady, N. Y., gives an interesting discussion of high-torque induction watt-hour meters and prepayment attachments, for recording the amount of electrical energy used, and for insuring that the proper payment is made therefor.

DIRECT-CONNECTED GENERATORS.—The Triumph Electric Company, Cincinnati, Ohio, has issued as bulletin No. 281 a well-prepared description of engine-type, direct-current generators. The essential features embodied in the construction of these machines are clearly illustrated and discussed at length.

VARIABLE-SPEED, DIRECT-CURRENT MOTORS.—The Westinghouse Electric & Manufacturing Company, Schenectady, N. Y., uses circular No. 1117 to present the advantageous features of the auxiliary pole type of direct-curent motors. These motors permit of a speed range of four to one on a single voltage by field control.

MACHINE CONTROLLERS.—Flyer No. 2174 of the General Electric Company, Schenectady, N. Y., illustrates and describes briefly speed regulating rheostats for use with shunt or compound-wound motors which drive machine tools or similar equipments. They are designed to reduce the speed by inserting resistance in the armature circuit.

PANELETTES.—The H. T. Paiste Company, Philadelphia, Pa., has issued bulletin No. 30, which describes panelettes, 125-volt and 250-volt rosettes, cut outs, attachment plugs and baby knife switches. Each panelette is a unit complete in itself, ready to install and there is not a wire to be found on the face. These are shown with and without branch switches.

MEASURING INSTRUMENTS.—Price List No. 5143 of the General Electric Company, Schenectady, N. Y., relates to electric measuring instru-

ments, including astatic ammeters and voltmeters, horizontal edgewise instruments, round pattern instruments, curve drawing instruments, ground detectors, synchronism indicators and line drop compensators for alternating current circuits.

COAL-HANDLING MACHINERY.—Catalogue 063 of the C. H. Hunt Company, West New Brighton, Staten Island, N. Y., deals with coal-handling machinery for power stations, boiler rooms, coaling stations, gas producers, coal yards, shipping docks, manufactories, etc. The catalogue is profusely illustrated, and no pains have been spared to show the constructional features of the apparatus.

BELT CONVEYORS.—The Robins Conveying Belt Company, Park Row Building, New York, has issued a series of single sheets No. 1 to 9 inclusive, explaining and illustrating belt conveyors for handling coal, ore, cement, refuse, etc. Each sheet is devoted to a certain type of conveyor, and the brief descriptive matter is effectively supplemented by illustrations showing the conveyor in actual service.

ROTARY CONVERTERS.—Bulletin No. 4,443 of the General Electric Company, Schenectady, N. Y., gives an instructive discussion on rotary converters for railway service. The advantages arising from using six-phase converters rather than three-phase machines are mentioned, and numerous diagrams are shown of the connections of transformer windings for obtaining six-phase currents from two-phase or three-phase circuits.

SWITCHBOARDS FOR ISOLATED PLANTS.—The General Electric Company, Schenectady, N. Y., has issued as bulletin No. 4,435 an illustrated description of isolated plant switchboard panels with circuit breakers. These panels provide for controlling 125-volt, direct-current generators of from 5 to 85 kw capacity and 250-volt generators of from 10 to 170 kw capacity. They also provide for the control of from two to six-feeder circuits.

RAILWAY AND LIGHTING SUPPLIES.—The latest catalogue of the Elmer P. Morris Company, 51 Dey St., New York, deals with wrought iron and steel tubular poles and pole brackets for electric railways, electric lighting, telegraph and telephone service and also a complete line of overhead line material used in the construction and operation of electric railways. This catalogue, which is designated as No. 12, will be sent to parties interested upon request.

NORTHERN ELECTRIC BULLETIN.—The electrical equipment produced by the Northern Electrical Manufacturing Company, Madison, Wis., is characterized by ease of application and convenience of arrangement, location, and operation. For certain classes of work a special type of variable speed motor, described in Bulletin 45, has been developed. Northern multi-speed motors, as they are termed, are especially designed for application to engine lathes. Bulletin sent promptly on request.

MACHINE TOOLS.—The 1906 edition of the general catalogue of the Brown & Sharpe Mfg. Co., Providence, R. I., which relates to machinery and tools, contains 514 pages, and has been thoroughly revised. The catalogue is invaluable as a book of reference to the workman, on account of the large number of tables and other general information which are found on its pages. This catalogue will be mailed to any address without charge upon application, or it may be obtained from hardware and supply dealers.

HARMONIC CONVERTER.—The Dean Electric Company, Elyria, Ohio, uses folder No. 5 to present the advantageous features of the harmonic party line telephone system and to describe the harmonic converter. The converter is a device for supplying alternating current for selective party line ringing. It is designed to do all of the ringing of the exchange including that of regular lines and toll lines, and with the proper selecting keys will furnish current for ringing selectively eight parties on rural lines.

LOOMIS-PETTIBONE GAS GENERATING PLANTS are attractively described by means of diagrams and colored plates in a new pamphlet that is being issued by the Power and Mining Machinery Company, Milwaukee, Wis. This system gasifies bituminous coal, wood, charcoal, lignite, etc., and produces a gas that is particularly adapted to the operation of gas engines. The water gas made by this system can be used separately in various feeding work, such as forging, welding, tempering, etc. This pamphlet can be had upon application to the company.

CENTRAL ENERGY TELEPHONES.—Bulletin No. 15, of the Stromberg-Carlson Telephone Monufacturing Company, Rochester, N. Y., is an extremely neat publication dealing with central energy telephones and their parts. Views are given of wall-telephones, "central energy" residence and hotel telephones, portable desk telephones, combination telephones, cabinet telephones, and telephone parts. The bulletin describes a new type of combination telephone, which has the hook in combination with the receiver, whereby the act of placing the instrument to the ear signals the central office.

AUTOMATIC CLUTCHES.—In booklet D, which is given the title "Clutchology," the Automatic Clutch Company, Akron, Ohio, gives an illustrated description of its automatic clutch which is self-adjusting and tightens the grip as the load increases. The enclosed clutch consists of a sleeve forming an oil-tight and dust-proof case which encloses the working parts of the clutch, allowing them to operate in a continuous oiled bath, and protecting them from dust and dirt. It is claimed that when the case is filled with oil, this clutch will operate for months without attention.

BUSINESS MANAGEMENT is the title of a pamphlet in neat form issued by Mr. W. F. Weiss, certified public accountant, 128 Broadway, New York. It is a clear, concise and comprehensive treatment of the functions of the public accountant, whose work enables the business man to get and keep a close grip on his affairs, so that he can tell at any moment how things are going, and on the information furnished him can increase efficiency, control expenses and win out where before he was suffering from unsuspected extravagances and losses, or was not pushing the right branches of his trade.

DIRECT-CURRENT MOTORS AND GENERATORS.—The Stanley-G. I. Electric Manufacturing Company has issued bulletin No. 601, dealing with high-grade, direct-current motors and generators. A few illustrations are given of motor application and accessories, also tables of much value to purchasers, enabling them to select the motor or generator best suited to their requirements. By referring to the tables and rules governing the installation of electrical apparatus, the proper method of wiring, as well as the size of wire, can be determined. Information is also given concerning the size of shafting, pulleys, belting and the distance hangers should be spaced apart.

SINGLE-PHASE INDUCTION MOTORS.—A bulletin of considerable practical interest has recently been received from the Wagner Electric Mfg. Co., St. Louis, Mo., dealing with single-phase, constant-speed, self-starting alternating-current motors. These motors receive their torque from being started as repulsion machines, while they operate as induction motors when full speed is reached and the secondary is closed upon itself. The conversion from the repulsion to the induction connections is accomplished either automatically by a centrifugal device, or manually by the variation of the resistance included in the secondary circuit. The features are discussed at great length in bulletin No. 75.

CONTROLLERS.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued a series of bulletins for its loose-leaf catalogue, dealing with the general subject of motor controllers. Bulletin No. 16 describes motor-starting rheostats with automatic release for switchboard mounting. Bulletin No. 45 is devoted to compound speed-regulators with renewable segments. Bulletin No. 70 treats of self-starters for non-reversible motors operating belted elevators, pumps, etc. Drum-type reversing switches for electric elevators are discussed in bulletin No. 72. Compound controllers for rotary printing presses are described in bulletin No. 65. Bulletin No. 67 relates to non-reversible drum controllers, while drum controllers with two reverse speeds especially adapted for printing presses are treated at some length in bulletin No. 68.

News of the Trade.

THE CONSOLIDATED ENGINE STOP COMPANY has recently moved its offices from 100 Broadway, New York, to 130 East 12th Street, where its New York City factory is located.

THE CENTURY ELECTRIC COMPANY, of St. Louis, filed a statement on March 22, to show that it had made an increase in its capital stock from $30,000 to $75,000, 60 per cent of the increase being paid in.

DOSSERT & CO., manufacturers of the Dossert cable joint, have recently moved into their new factory at 242 West 41st St., New York. The plant is equipped with all the newest machinery obtainable in order to take care of their increasing business. Mr. H. B. Logan is now general manager of this company.

THE TETER-HEANY DEVELOPING COMPANY, of York, Pa., is being reorganized preparatory to establishing a large new plant for the manufacture of Teter-Heany fireproof insulating wire. The company will have a capital of $500,000, and the following are the officers: W. F. Bay Stewart, president; Daniel F. Lafean, vice-president; William F. Ramsey, secretary; Charles C. Frick, treasurer.

MR. ARTHUR P. STANLEY, who has widely been known for the past twenty years in the field of electrical manufacturing and supplies in New York City, has resumed his connection with the firm of P. M. Fletcher Company, with which he started in the electrical business a score of years ago. The firm's offices and headquarters are at 32 and 34 Frankfort Street, where Mr. Stanley hopes to be found until at least 1926.

THE DEWEY DOCK.—The Dewey floating dry dock, the largest floating dry dock ever built, has so far withstood the raging storms at sea, and is now again on its way to Cavite, Philippine Islands, where it is intended for service. A somewhat novel feature of this huge structure is the complete lighting plant. The essential factor in this installation is a generating set furnished by the B. F. Sturtevant Company, of Boston, Mass.

THE SPLITDORF LABORATORY at 17 to 27 Vandewater Street, New York, has grown so rapidly within the last few years that at present it is doubtful if it is not one of the largest laboratories of its kind in America. It is one of the oldest, having been established nearly fifty years and its staff now comprises some of the best talent to be procured in the technical field. It makes a specialty of developing inventions and experimenting with and perfecting all kinds of electrical and scientific apparatus and machinery.

POWER AND MINING MACHINERY COMPANY.—In order to better handle its rapidly increasing business from the Rocky Mountain District, the Power & Mining Machinery Company, Milwaukee, Wis., has opened an office at 312 17th Street, Denver Col. This new office is in charge of Henry F. Jurs as district manager, who will give his personal attention to all inquiries coming from Colorado, Wyoming and New Mexico for the varied lines of machinery manufactured by this company. Mr. Jurs is thoroughly acquainted with his territory through his recent connection with the A. Leschen & Sons Rope Company, St. Louis, as its western manager

in Denver. Mr. Jurs began his career as a machinist, working his way up through the draughting room. He then entered the service of the Union Iron Works, San Francisco, California, and was regarded by them as their most capable commercial engineer. He left the Union Iron Works to take a position with the Baker & Hamilton Company, San Francisco, in charge of its steam engine and boiler department, and later was made manager of its large shops located at Benicia, Cal.

THE BOSTON INCANDESCENT LAMP COMPANY, of Danvers, Mass., is remodelling the building formerly occupied by the skating rink and will establish its factory and offices therein when completed. It is expected that the building will be ready for occupancy by May 1. New electrical apparatus and machinery will be installed, and when fully equipped the factory will be one of the best for the manufacture of incandescent lamps.

D. ROUND & SON, of Cleveland, Ohio, manufacturers of chains and chain hoists, are making a specialty of the Simplex portable crane and hoist, a very convenient outfit for the repair shop for handling armatures, motors, wheels, axles and other heavy articles up to two tons. The device, which is made in eleven sizes, is compactly built and has large wheels causing it to roll easily. The company also makes a large line of chain hoists, screw hoists and trolleys.

THE CLEVELAND ARMATURE WORKS, of Cleveland, Ohio, is preparing to erect a new factory building at St. Clair and Kirtland Streets, that city. The new building will have a floor space of 16,000 square feet. All machinery will be electrically driven and the various machine tools are now being equipped with motors which the company is manufacturing itself. Heretofore it has confined its efforts to the production of motors up to 10 hp, but after the new factory is started it will build motors up to 25 hp.

ALLEN FLUXES.—The following letter received by L. B. Allen Company, Inc., Chicago, manufacturers of Allen-flux and other electrical compounds, from New Orleans, La., under date of March 12, 1906, shows how this enterprising firm is exploiting its products to the consumers throughout the country so as to benefit its jobbing dealers: "Yours of the 9th inst. received, and must say that I have already acknowledged receipt of your samples and have tried them and found them to work perfectly. Am very pleased at the result."

A LARGE PIPE COVERING CONTRACT.—The H. W. Johns-Manville Company, through its Chicago branch, has just completed a large contract for the installation of "Fire Felt" pipe and boiler covering in the new plant of Sears, Roebuck & Co., of Chicago, involving an expenditure of several thousand dollars. "Fire Felt"is absolutely fireproof, elastic, light in weight, and unaffected by expansion or contraction of pipes. The above is but one of many large contracts that this company has recently executed all of which bears testimony to the fact that the largest and most exacting firms have found it to their advantage to place work of this kind under the supervision of experts.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 20, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N.Y.]

815,330. LAMP RHEOSTAT; Thomas J. Bull, New York, N. Y. App. filed June 15, 1903. A resistance designed to be inserted into the usual lamp socket for the purpose of operating miniature incandescent lamps. A cylindrical casing contains a lamp having an air space around it for cooling purposes, to cut off the light from the lamp. The casing also has a resistance winding which can be varied.

815,356. SYSTEM OF EXCITATION FOR INDUCTION MACHINES; Maurice Leblanc, Paris, France. App. filed Jan. 28, 1903. The combination of a course of multiphase current, and a phase-regulating dynamo-generator of the direct-current type having its armature connected to the several branches of the multiphase circuit and having its field traversed by a periodically-varying flux.

815,357. PROCESS OF EXCITATION FOR INDUCTION MACHINES; Maurice Leblanc, Paris, France. App. filed Feb. 5, 1904. The process of producing the effect of an added negative resistance in one member of an asynchronous machine by impressing thereon an electromotive force of the frequency of the current in that member, but of a phase in opposition to the voltage inserted by such current.

815,360. DEVICE FOR RECHARGING THE STORAGE BATTERIES OF AUTOMOBILES; Lamar Lyndon, New York, N. Y. App. filed Mar. 23, 1905. A special type of induction motor having two commutators is employed upon a vehicle and when the batteries are charged from an alternating current circuit the motor is arranged to be operated as a rotary transformer, so that the batteries may be properly charged.

815,365. ELECTROMAGNET; Ernest H. Miller, Lancaster, Pa. App. filed Nov. 26, 1904. A form of solenoid magnet designed to secure a large power for the purpose of working magnetic brakes. A pair of solenoids are assembled upon a yoke which has conical studs projecting therein and the armature is of U-shape with internally coned pole faces.

815,370. SAFETY EQUIPMENT FOR SERIES ELECTRICAL DISTRIBUTION SYSTEMS; Frederick J. Murman and Albert B. Shreve, Mount Vernon, N. Y. App. filed May 2, 1904. An arrangement for cutting out defective apparatus in a series circuit. At various points a shunt is arranged which is normally open by a minute spark gap. In case of a defect in any apparatus, the resulting high potential at the gap causes a jump spark which actuates a magnetic circuit closer through the shunt.

815,380. TELEPHONIC APPARATUS; John G. Roberts, Detroit, Mich. App. filed June 26, 1900. In combination with the ringing apparatus of a telephone substation, a ringing device located at the central station, consisting of a continuously revolving shaft, an armature revolving therewith capable of movement longitudinally in the line of the shaft, a circular electromagnet concentrically embracing the shaft, but elastically attached to a fixed portion of the sustaining frame, electrical means for energizing said electromagnet for the purpose of bringing the armature in contact therewith, whereby said armature compels a partial rotation of the electromagnet, means attached to the periphery of the electromagnet whereby a series of ringing contacts are made to actuate the ringing mechanism at the substation, an electromagnetic means for automatically discontinuing the circuit energizing the electromagnet whereby the armature is released therefrom and the electromagnet returns automatically to its original position by virtue of the resiliency of its elastic connections.

815,384. STATIC DISCHARGER AND LIGHTNING ARRESTER; Henry M. Shaw, East Orange, N. J. App. filed Feb. 8, 1905. A lightning arrester for high potential circuits employing a series of spaced carbon rings of peculiar form separated by perforated mica discs. The purpose is to give a spark gap for lightning discharges which will not induce an arc for the main current.

815,405. AUTOMATIC RINGING AND LISTENING KEY; Albert Carliss, Chicago, Ill. App. filed June 20, 1901. An attachment for telephone switchboards having an upwardly projecting lever with a knob which can be thrown in alternate directions. The knob presses different contact blades together and under certain circumstances is locked by an electromagnet.

815,406. AUTOMATIC ELECTRICAL SELF-SOLDERING RESET FOR THERMAL PROTECTORS; Frank B. Cook, Chicago, Ill. App. filed Apr. 27, 1905. The thermal coil is disposed in a cylindrical casing which is normally soldered against rotation. A spring member bears against the cylinder to produce rotation in case the solder is melted. After actuation the solder hardens so that the device may be reset in a new, but operative relation.

815,418. INSULATOR FOR ELECTRIC APPARATUS; Harleston C. Gesner, New York, N. Y. App. filed June 26, 1905. Insulator or high resistance consisting of particles of an alloy of iron and hydrogen fritted into a coherent mass.

815,419. PRODUCTION OF ARTICLES OF ALLOY OF IRON AND HYDROGEN AGGLOMERATED IN STRONG COHERENT BODIES; Harleston C. Gesner, New York, N. Y. App. filed July 7, 1905. An article consisting of particles of an alloy of iron and hydrogen, compressed and agglomerated into strong coherent bodies.

815,444. MOTOR; Frank E. Lewis, Troy, Ohio. App. filed June 15, 1905. An enclosed motor of the usual bi-polar type in which the two poles are each formed of a pair of closely adjacent poles lying in separate magnetic circuits.

815,459. ALTERNATING-CURRENT MACHINERY; Addams S. McAllister, Ithaca, N. Y. App. filed Dec. 14, 1903. A single-phase alternating-current generator made up of a plurality of field-core sections; a plurality of field coils, one on each section and each coil closed upon itself and free from connection with the others of said coils, and an electric circuit including a rotor provided with a commutator; a plurality of sets of brushes adapted to contact with said commutator; lead wires; and a switch for connecting at will either of said sets of brushes with said lead wires.

815,471. INSULATOR; George L. Ricks, Yuma, Arizona Territory. App. filed Mar. 8, 1905. The two parts of a porcelain insulator can be nested or fitted together so as to clamp a wire there between when the insulator is screwed upon a supporting surface.

815,490. ELECTRICAL GUN; Martin E. Thomas, Batavia, Iowa. App. filed Nov. 1, 1905. A gun designed to fire a gun-powder charge by electricity. Has dry batteries and a spark coil in the stock by which a jump spark can be induced through the powder chamber.

815,498. ELECTRIC CONDUCTOR; Welby D. Weir, Winnsboro, Texas. App. filed Feb. 15, 1905. A telephone connection for telephone switchboard formed of a pair of concentric chains somewhat similar to the well known flexible metallic tubing. The purpose is to avoid breakage by continued wear, incident to the usual stranded connections.

815,499. AUTOMATIC OVERHEAD TROLLEY CONTACT DEVICE FOR OPERATING ELECTRIC SIGNALS; Beecher D. Whitcomb, Shawomet Beach, R. I. App. filed Nov. 20, 1905. Supported by the usual hangers and guy wires of the trolley is a frame having a compound lever arrangement with a depending tappet in the path of the trolley wheel. The movement is such as to trip a contact lever into operation during the passage of the car.

815,506. INSULATOR; Herbert S. Blynt, Steubenville, O. App. filed Jan. 7, 1904. A porcelain block has a specially-formed groove therein so constructed as to impart a kink or bight to the wire when the latter is stretched there through. The insulator is designed to hold the wires upon a wall or similar surface.

815,548. PROCESS OF PRODUCING AROMATIC ALCOHOLS AND THEIR DERIVATIVES; Charles Mettler, Munich, Germany. App. filed Nov. 2, 1904. Process for the production of aromatic alcohols and their ethers, which consists in exposing the aromatic ethers in a dissolving agent, capable of conducting the electric current in the cathode space of an electrolytic apparatus in using for the cathode a material of a specially high cathodic tension, then neutralizing the cathode liquid, then separating the reaction product and finally distilling.

815,557. ALARM FOR INCUBATORS; Fay T. Porter, Morristown, Ind. App. filed May 20, 1905. The usual incubator has a thermostat therein, the lever of which is extended outside of the incubator box and has hood or cap which is dropped over the usual air-circulating opening in case the temperature falls to a low limit. At the same time an alarm circuit is completed.

815,578. CONTROLLER OPERATING MEANS; A. J. Brown, Norwood, O. App. filed July 11, 1904. The controller handle is connected to the controller shaft through an intermediate spring connection and a specially arranged detent resists movement of the controller shaft until after a predetermined movement of the handle has taken place. The shaft then follows the handle with an abrupt movement.

815,605. ELECTRICAL CONNECTOR FOR ELECTRIC LAMPS; Ernest A. Lowe, North Plainfield, N. J. App. filed Jan. 21, 1905. The threaded shell, and the central stud, of the socket are both connected to needle points which are contained in guiding grooves adapted to receive the usual circuit wires. The connections are thereby made through the needle points.

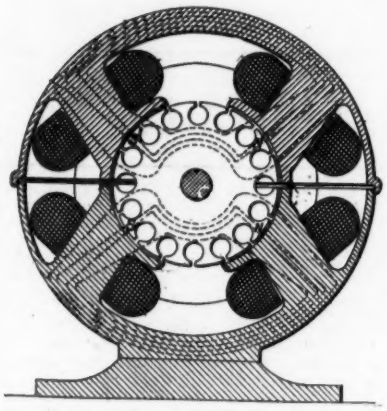
815,628. SECONDARY BATTERY; Emil L. Oppermann, London, England. App. filed Apr. 11, 1905. A composite material for secondary electric battery plates, consisting of active paste containing finely-subdivided filaments of material destructible by the electrolytic action of battery liquid, said filaments not exceeding one-sixteenth of an inch in length.

815,673. CONCENTRATOR; Quincy Bent, Lebanon, Pa. App. filed Apr. 14, 1904. An inclined table is mounted to have imparted to it the usual vibratory motions, and is studded with small electro-magnets.

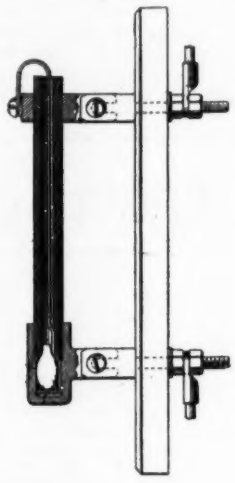
815,679. CONCENTRATOR; Harry H. Campbell, Steelton, Pa. App. filed Apr. 14, 1904. 815,729. Relates to modifications of the above, and particularly to the arrangement by which the electro-magnets have a special movement independent of the movement of the table and transverse thereto.

815,729. TRANSFORMER; Walter S. Moody, Schenectady, N. Y. App. filed Dec. 13, 1901. In order to avoid the excessive insulation ordinarily required about the cores of a transformer, the windings are arranged with the secondary outside on one core and inside on the other. This arrangement brings the low potential parts of both primary and secondary adjacent the cores. With this arrangement a less insulation is required than otherwise.

815,746. FUSE CLAMPING TERMINAL; Arthur C. Savage, Schenectady, N. Y. App. filed July 20, 1904. A pair of clamp jaws move diagonally toward one another by a screw connection so as to exert a very heavy clamping force upon the fuse wire.



815,444—Motor.



815,804—Thermal Cut-out.

815,752. TELEPHONE ATTACHMENT; Joseph Silverman, San Francisco, Cal. App. filed Jan. 25, 1905. The combination with a receiver and mouthpiece of a telephone, of a holding device for the receiver said device comprising a stand having a vertical standard, a carriage supported on the standard and having a portion extending from one side, an arm lying in a plane at one side of the standard and having its inner end bent at right angles and pivotally secured to the extended portion of the carriage and a swiveled clasp on the outer end of the arm adapted to support the telephone receiver.

815,753. TELEPHONE ATTACHMENT; Joseph Silverman, San Francisco, Cal. App. filed Nov. 23, 1905. The combination with a telephone of an attachment therefor having means for holding down the hook, said means including an adjustable arm carrying a vertically reciprocating part to embrace the hook, a spring on said arm operating on the hook in opposition to its tendency to lift, and means for reciprocating said part in opposition to said spring.

815,756. SYSTEM OF ELECTRICAL CONTROL; Frank J. Sprague, New York, N. Y. App. filed Sept. 22, 1898. The combination of a motor, a source of supply, means for connecting the motor to the source of supply, a shunt around the motor, a controller for the motor, and means for opening the shunt when the controller is brought to a predetermined position.

815,765. ELECTRIC TRANSFORMER; Matthew O. Troy, Schenectady, N. Y. App. filed Oct. 20, 1904. A three-phase transformer in which the primary windings are connected in the usual delta formation, while the secondary coils are lapped into a special circuit with one another, the purpose of which is to prevent the usual unbalancing of voltage in the secondary windings.

815,764. ELECTRIC PLUG CONNECTION; Julius C. Tournier, Schenectady, N. Y. App. filed July 11, 1904. Details of a porcelain plug connection having a threaded shell, and the usual central stud extended into an interior chamber from which the usual connections are made. The plug is designed to receive a fuse wire if desired.

815,804. THERMAL CUT-OUT; Charles E. Eveleth, Schenectady, N. Y. App. filed Aug. 4, 1903. The end of a fuse wire is soldered to a fusible plug of a "sparklets" capsule. When the fuse wire melts the rush of cold carbonic acid gas blows out the arc formed thereby.

815,809. TELEGRAPH KEY; John J. Ghegan, Newark, N. J. App. filed Jan. 28, 1905. A form of telegraph key having a spring lever supported to vibrate in a horizontal plane. The lever has a vertical flat disc for the engagement of the fingers.

815,814. MEANS FOR PREVENTING ACCUMULATION OF STATIC ELECTRICITY UPON BELTING; Charles M. Green, Lynn, Mass. App. filed Feb. 5, 1903. The patentee proposes to render the surface of a belt conducting so as to dissipate static electricity. For this purpose the belt is painted with a graphite compound or is threaded with a network of metallic wires.

815,822. RELAY; Reinhold Heramn, Crafton, Pa. App. filed Mar. 28, 1904. Details of a relay having a magnet hung from the glass casing of the instrument, and having a contact lever with a conical carbon point, through which the electrical connection is made.

815,824. HIGH POTENTIAL SWITCH OR CIRCUIT BREAKER; Edward M. Hewlett, Schenectady, N. Y. App. filed Feb. 7, 1900. A circuit breaker for high potential circuits having a yoke with the switch rods depending therefrom and worked by pneumatic cylinder. The switch rods plunge into an enclosed oil bath before engaging the sockets by which the circuit is completed.

815,825. ELECTRIC SWITCH; Edward M. Hewlett, Schenectady, N. Y. App. filed July 27, 1904. Another form of high potential circuit breaker in which the movable element consists of metallic rods or bridges clamped about insulators on the movable member, and which are moved through an oil bath against stationary spring blades.

815,826. TRAIN CONTROL SYSTEM; George H. Hill, Schenectady, N. Y. App. filed Aug. 20, 1904. Details of a train control system in which the usual contactors while normally controlled by the pilot circuit as at present are rendered inoperative in case there is no current in the motor circuit of that particular car.

815,831. APPARATUS FOR OBSERVING THE OSCILLATIONS OF LIGHT BEAMS; Andreas W. Hornauer, Charlottenburg, Germany. App. filed May 13, 1904. The light beam is directed against a revolving cylinder having a non-circular contour, the effect of which is to cause a peculiar curve to be generated in space by the spot of light on the cylinder. The changes in the form of this curve indicate the changes in the electrical circuit which is being studied.

815,836. VAPOR ELECTRIC APPARATUS; Alexander M. Jackson, Schenectady, N. Y. App. filed Jan. 29, 1906. In order to avoid the blackening of mercury-vapor tubes by the disruption of the anode caused by the mercury molecules impinging there against, the patentee surrounds the anode with a special form of condensing chamber which serves to protect the glass of the casing from being blackened.

815,847. DYNAMO ELECTRIC MACHINE; John P. Mallett, Madison, Wis. App. filed May 21, 1904. The laminated pole face has grooves extending there across through which bolts pass so as to clamp a pair of castings on the edges of the poles. These hold the usual magnet coil in place.

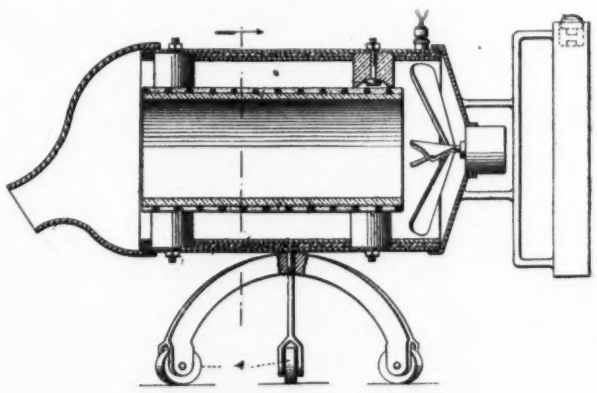
815,863. VARIABLE VOLTAGE ELECTRIC TRANSFORMER FOR CAUTERY AND DIAGNOSTIC WORK; Earl H. Rollinson, Albany, N. Y. App. filed July 18, 1905. The primary element of the transformer is wound on a support which is movable relatively to the secondary so that the secondary current may be varied as required.

815,875. PROCESS OF DEEP ETCHING OF ZINC BY ELECTROLYSIS; Otto C. Strecker, Darmstadt, and Hans H. Strecker, Mainz, Germany. App. filed May 26, 1904. The hereindescribed electrolytic process of deeply etching zinc which consists in exposing a zinc plate as an anode to an electric current of at least two amperes per square decimeter of the active surface while submerged in a path of zinc-salt.

815,881. PROCESS FOR THE REDUCTION OF ORES; Clinton P. Townsend, Washington, D. C. App. filed Apr. 12, 1902. The herein-described method of reducing sulfid ores, which consists in supporting the ore in a body of fused electrolyte which is substantially inert toward the ore and passing an electric current to said ore as cathode.

815,889. TELEPHONE TRANSMITTER; Ernest E. Yaxley, Chicago, Ill. App. filed Sept. 26, 1905. A telephone transmitter including a speaking diaphragm, an electrode actuated thereby, a second electrode, a chamber and subdivided material within said chamber interposed between and in contact with said electrodes, said chamber including an apertured resilient diaphragm engaging the inner face of the electrode moved by the speaking diaphragm, the said subdivided material having access to the electrode moved by the speaking diaphragm through the aperture in the diaphragm forming a part of said chamber.

815,890. ELECTRIC SIGNALING SYSTEM; Samuel M. Young, New York, N. Y. App. filed Oct. 18, 1904. A railroad signal system in which the track is divided into sections and the successive sections are energized with alternating currents. Inductive bonds are employed for connecting the various sections so as to insulate them against the alternate currents without impairing their continuity to the direct. The signal circuits are worked by the short-circuiting of the alternating potential in the usual way.



815,915—Hot Blast Apparatus.

815,891. ELECTRIC SIGNALING SYSTEM; Samuel M. Young, New York, N. Y. App. filed Oct. 18, 1904. Relates to modifications of the above and particularly to a feature by which the two tracks are connected by inductive bonds so as to be insulated from one another against alternating currents but in communication for the passage of direct currents.

815,903. FLUID PRESSURE SYSTEM; Frank E. Case, Schenectady, N. Y. App. filed Feb. 24, 1903. The air compressor is driven by an eccentric on the car axle which is made operative by a magnetic clutch electrically operated in case the pressure of the reservoir falls below a certain amount.

815,908. RHEOSTAT FOR STARTING AND CONTROLLING ELECTRIC MOTORS; Winterton J. Day, Schenectady, N. Y. App. filed Sept. 14, 1904. The usual no-voltage release coil of the rheostat is disposed upon an arm which can be set at various positions so that the motor may be set for a slow speed if desired.

815,915. HOT BLAST APPARATUS; Joseph Fallek, New York, N. Y. App. filed July 10, 1905. Specific construction of a heater having a resistance coil surrounding the casing through which air circulates under the influence of a fan. Switches are arranged for independently controlling the heating circuit and the motor circuit.